Aeronautics

IN THE ISSUE OF FEBRUARY, 1930

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AERONAUTICS Advertising Advisory Board: J. Don Alexander, C. H. Biddlecombe, Archibald Black, Stedman Hanks, P. G. Kemp, George Pynchon, Jr.

Harry Frank Guggenheim

The aviation industry owes a debt of gratitude to Mr. Guggenheim, now United States Ambassador to Cuba for his great service as president of the Daniel Guggenheim Fund for the Promotion of Aeronautics.

XUM

"Simple duty hath no place for fear"
Whittier

From THE PUBLISHER'S QUILL

Aeronautics ADVOCATES

A unified air service with adequate appropriations.

A great National Air Academy.

Repeal of tax on gasoline sold on air fields.

Unified State and National laws governing aircraft.

THE AERONAUTICS ADVISORY BOARD

IT is with much pleasure that we formally announce to our readers the individuals who will form the AERONAUTICS Advisory Board. Each member of the Board has distinguished himself in some branch of aeronautical activity and, as a group, form a distinguished and talented reference body. The AERONAUTICS Advisory Board will serve as a unit or individually and will be available to our readers who wish information or opinions along with or in addition to that which we are in a position to give.

We especially wish to call this Board to the attention of National and Sectional lawmakers both judicial and legislative. The opinions of the AERONAUTICS Advisory Board can well be sought before proposed bills affecting aviation activities are actually effected. The opinions of the members of this Board may not alter the course of action of any individual but the fact that the opinion was sought would reflect highly on the good intentions of the inquirer. For example, Congressman John L. Cable called upon us several months ago to secure a cross section of aeronautical opinion on his proposed legislation on airlines. The consensus seemed to be against Representative Cable's idea, and his bill nevertheless was presented to Congress—but certainly his good intentions and his desire to consider the interests of all concerned can not be questioned.

J. Don Alexander will serve as authority on Dealer's Sales. Mr. Alexander was born in Missouri in 1885 and is president of the Alexander Aircraft Co.

Archibald Black will serve as authority on Transportation. Mr. Black was born in Scotland in 1888, designed the airplane in which the first Liberty engine was installed, was consulting engineer to the U. S. Air Mail Service in 1921, and now heads the firm of Black and Bigelow, well known aerial transport engineers.

Louis Bleriot will serve as authority on French Activities. M. Bleriot was born in 1872, was the first man to fly across the English Channel (1909), and now heads a great French aeronautical firm bearing his name.

Capt. R. J. Goodman-Crouch will serve as authority on Engineering. Capt. Goodman-Crouch was the official delegate from Great Britain to the Civil Aeronautics Conference held a year or so ago and was drafted from Great Britain to serve as vice-president and director for the Whittelsey Mfg. Co., Inc.

Henry Joseph Cox will serve as authority on Meteorology. Mr. Cox was born in Massachusetts in 1863. He has been in the weather service since 1884 and is now in charge of the North Central Forecast District for the Weather Bureau of the United States Department of Agriculture.

Sherman Mills Fairchild will serve as authority on Aerial Photography. Mr. Fairchild was born in New York in 1896, invented the Fairchild aerial camera, was an important factor in the development of the aerial mapping industry, and now heads the Fairchild Aviation Corporation and subsidiaries.

Warren Irving Glover will serve as authority on Air Mail. Mr. Glover was born in New York in 1879 and since 1925 has been 2nd assistant Postmaster General.

Lady Mary Heath will serve as authority on Women's Activities. Lady Heath is an internationally known English aviatrix now established in America. She received the first aviation mechanics license ever issued to a woman by the United States Department of Commerce.

Charles Sherman (Casey) Jones will serve as authority on Flying Schools. Mr. Jones was born in Vermont in 1894, entered the Army Service in 1917, served at the front with the 96th French Pursuit Squadron, and now heads the Curtiss-Wright Flying Service.

Professor Alexander Klemin will serve as authority on Aerodynamics and Structures. Professor Klemin was born in 1888. He has been engaged in English aeronautics, was instructor in Aeronautics at M.I.T., consultant to several American aeronautical corporations as well as to the U. S. Government, designer of the first American amphibian and several Army and Navy planes, and now is in charge of the Daniel Guggenheim School of Aeronautics at New York University.

B. Russell Shaw will serve as authority on Airports. Mr. Shaw was born in Ohio in 1893. He has designed and redesigned several types of airplanes, has served as consulting engineer to several American aeronautical firms as well as to representatives of the Imperial Japanese Navy. He was the inventor and manufacturer of the Vertimeter (rate of climb indicator), technical supervisor for several Air Races and now heads the St. Louis firm of airport construction engineers which bears his name.

As the necessities of the aeronautical industry arise, new members will be added to this board.

In order that our readers may become better acquainted with these outstanding personalities we are reproducing a photograph of each Adviser on pages 26 and 27 of this issue.

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XUM

SERVICING A

by Z. M. Allison

ALL the world's a market place for airplanes, but the best market is obviously the one in which the airplane can be used to the greatest advantage. This "best market" is without doubt Latin America. The Bureau of Foreign and Domestic Commerce in one of its official bulletins says, "Latin America is *naturally* regarded by manufacturers of aircraft and accessories as presenting the best export market."

No less a person than Herbert Hoover has seen the possibilities of South America as a market for airplanes and other manufactured wares. The Department of Commerce, stimulated by its ex-chief who is now president, is making a gallant and a very successful effort to secure data that will be useful to exporters of aircraft.

The information obtainable at the offices of the Department of Commerce has been gathered for the government by the ablest men obtainable, whose efforts have been backed up by the authority and resources of the Federal Government. The exporter should by all means keep in close and constant touch with the Bureau of Foreign and Domestic Commerce.

The best immediate market in Latin America is the Republic of Argentine; the richest and most highly developed of all the great Republics to the south of us. Buenos Aires, the capital city of the Argentine, is in very truth the Paris of the new world—a later and a more beautiful Paris. Buenos Aires is the most modern city in the world. Mr. Messersmith, our able and amiable Consul-General in the Argentine, estimates the population at something less than 3,000,000 and of the Argentine at 13,000,000. These 13,000,000 are nearly all Caucasians.

For present purposes the key cities to South American trade are Buenos Aires, Rio de Janeiro, Santiago (de Chile), Lima and Bogota. Caracas in Venezuela and La Paz in Bolivia ought also to be considered, but these territories can be handled from headquarters in other cities until such time as the exporter shall have established himself in the more populous and more prosperous sections.

The largest city in Latin America and its greatest center of trade is Buenos Aires. The American exporter of aircraft will probably consider this great city and the adjacent territory as the best place from which to conduct his first sales campaign.

The first step indicated by good export practice is to get in touch with the United States Bureau of Foreign and Domestic Commerce. The "bureau" is a very efficient organization and has departments especially designed and equipped to assist the manufacturer of airplanes in the solution of his export problem.

The "bureau" will furnish reports on publications that might be used for advertising. These reports are comprehensive and are kept up-to-date. The man or firm that contemplates going into foreign markets ought to secure these reports. He also can and should avail himself of the other information offered by his Uncle Sam, for example, Trade Information Bulletins and mailing lists. Our trade commissioners keep the "bureau" posted on developments in export markets. They also send in the names and addresses of firms or individuals who are likely buyers of planes. These mailing lists are at the disposal of whoever can make legitimate use of them.

It's too bad that the "bureau" doesn't advertise. The writer has had the not uncommon experience of being offered a sum of money for information that is supplied free to all by the United States Department of Commerce. The Department has an aeronautics division and a merchandising department of the Aeronautics section. This department is headed by Mr. Leighton W. Rogers, whose address is U. S. Department of Commerce, Washington, D. C. Mr. Leighton and his staff will gladly cooperate with the exporter and will put at his disposal the reports of the special agents whose job is to get accurate information about foreign markets.

After the market has been analysed and it has been decided to exploit it, the next step will be to determine the best method for merchandising airplanes in the country or city selected. There is no precedent excepting that established by the automotive industry. Automobiles and airplanes have much in common, both offer transportation. They are being sold, generally speaking, on a common plan. In several instances automobile dealers in Latin America have also undertaken the distribution of airplanes.

Above is shown the hurry and blurry of the public market, at Puerto Colombia, South America.

NEW MARKET

Mr. Allison continues his authoritative articles on the South American market. In his article he suggests methods of establishing an aeronautical sales organization.

A view of Rio de Janeiro, showing the entrance to the harbor, which is one of the best in South America.

A tie-up with a dealer in automobiles ought to result favorably for the American firm who has planes to sell. In the first place the automobile dealer has an organization familiar with conditions peculiar to his locality. He knows the financial status of numerous owners of trucks, busses and private cars. He may also know who in his territory contemplates the early purchase of an airplane. The man in the United States can get full and accurate information about his prospective dealer in Buenos Aires from the American Chamber of Commerce in Buenos Aires, or from the United States Consul.

The dealer will not as a rule tie up any considerable sum of money in new and untried merchandise. A great many Yankee firms operate in export markets on a consignment basis. This is not, to be sure, the most satisfactory way of doing business so it is up to the exporter to sell his dealer the idea of co-operation for the profit of all concerned. After he has been sold on the merchandise and on the firm behind it, the dealer will usually agree to a quota and will make satisfactory arrangements for financing shipments on his account.

An airplane by its very nature is sold by demonstration. It will therefore be necessary to send to Buenos Aires a man who is first of all a pilot and a good one. He must also speak Spanish and ought to be carefully trained to adapt himself and his methods to the customs of his market.

A view of Buenos Aires, looking west from the Barolo building. In the foreground is Capital Square.

The salesman will leave the States equipped with all the information his firm has secured from the Department of Commerce, the Chamber of Commerce and other sources. Upon his arrival in Buenos Aires he should go at once to one of the better class hotels and take a bedroom and a small parlor adjoining. The parlor is used as a temporary office.

It is a poor plan for the salesman to get to work as soon as he arrives. He ought first to get in touch with the United States Consul and the Chamber of Commerce. There are also the commercial attachés, trade commissioners and other representatives of our Department of Commerce. The salesman will do well to call on these gentlemen; they are likely to offer information and advice that will save the newcomer time and money. Still more important, they will enable him to steer clear of the great old American habit of doing the wrong thing.

The man from the home office must co-operate in every way possible with the local dealer. The dealer isn't going to do the missionary work without assistance from the home office. His job, as he sees it, is to act as distributor for the company that manufactures the plane. As a distributor he is, of course, interested in making sales, but he reasons and reasons correctly that the manufacturer must create a demand or retire from the market leaving his erstwhile distributor free to make other and more profitable connections.

The job of creating a demand or preference is a big one, but the history of our export business in Latin America

is that demand is created and sales made at a comparatively low cost by men from the States—men who have the will and the ability to see things as they are—to see them from the customer's viewpoint.

The salesman from the States must have some knowledge of the fundamentals of advertising. One of America's leading exporters said in a speech before the Export Manager's Club of New York: "We depend on our salesmen to select the media to be used in his territory."

The fundamentals of advertising and selling are the same the world over, but the application differs. Successful cooperation with a foreign distributor consists, among other things, upon the ability of the man from the States to advertise at the right time in the right place and through the best media.

It may seem that the man who can sell airplanes in the Argentine is an impossible super-man, but he isn't. All the needed qualifications are embodied in many young Yankees and in some not so young.

At a recent meeting of the Export Managers Club of New York, it was agreed that the export salesman should possess certain definite qualities and qualifications, among these a knack for languages, imagination, the ability to secure trade information and base a workable policy on such information, an understanding of the fundamentals of advertising and of international trade, energy, personality and education.

A large order, but it can be filled. America's leading exporters usually take a young man from their own organization and give him whatever additional training he needs, which usually consists of an intensive course in international commerce and a brushing up in modern languages. The man selected nearly always had a working knowledge of Spanish or French or both.

A modified Spanish is spoken in the Argentine. There is a tendency to overstress the importance of local idioms, but the idiom of the Argentine merits the attention of the man who expects to sell airplanes to Argentinos. There are perfectly good Spanish words that have a double or doubtful meaning in Buenos Aires. These should be learned and avoided.

One of the fashionable streets of Rio de Janeiro, Rua Paysandu.

We Yankees talk shop and enjoy it at all times. This isn't done in South America or in any other place outside the United States. The niceties of social intercourse are more religiously observed in South America than in the land of the hustling and informal Gringos.

The enthusiastic young man who is selling the best airplane in the world must refrain from singing the praises of his crate at the dinner table of a prospective purchaser—that is, supposing he is fortunate enough to be invited to dinner.

The Argentinos are justly proud of their beautiful city of Buenos Aires. They are proud of the remarkable things they have accomplished in so short a time—proud of their magnificent boulevards, public buildings and private homes. The salesman will do well to see and to audibly appreciate these things. He ought also to remember that he is a guest in the home of a neighbor who is also a stranger. The guest must be on his good behavior. All of us must conform to the laws and customs of whatever country we are in. To the salesman in South America the most important laws are unwritten.

The unwritten law of the Argentine is that goods are bought rather than sold. The salesman contacts his customer by means of a letter of introduction. The first call is usually for the purpose of getting acquainted. The caller exhibits his credentials, gives a brief history of his firm and states that Senor S. may refer to a certain bank, which bank is a branch or correspondent of the firm's bank back in the United States. The customer has learned by experience that it is a good thing to check up on banking connections and to assure himself that the American firm he contemplates buying from is one that ships as per order and is generally reliable.

Every salesman who has gone to Buenos Aires and oversold or misrepresented his product has helped to build up a sales resistance that must be broken down and can be broken down by the man who is willing to adapt himself and his methods to the requirements of his customer.

Clothes make the man in many parts of the world. One of these is South America. If you are the trusted agent of a high class firm you must dress the part—must dress in the manner indicated by the usages of the people with whom you are dealing. You must also stop at a good hotel, club or private home.

It's expensive to live and do business in South America, but the rewards of doing the thing right more than justify the expense. To neglect the important trifles is to foredoom oneself to failure.

In dry weather it is possible to drive across the level treeless pampas without benefit of roads. Nearly all of this vast region is a natural and a perfect landing field—an ideal country for sport or

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The Atlantic City of South America, Montevideo, Uruguay. Above shows a section of the beach where the elite of South America gather each Summer.

THE RUSSIAN AIR FLEET

by

King Hamilton Grayson

A Russian air battalion recently brought into service during the controversy over the Manchurian Railway is shown at the Central Frunze Airfield, Moscow.

TWO million members of Ossoaviakhim have fixed as their goal five thousand aviation centers and the world's greatest air fleet. Thirty-two thousand branches of the Society are solidly behind the movement, and their members talk it seven days in the week, winding up each one with a Sunday Lottery for the further financial advancement of the ambitious program.

The real start by the Soviets dates from May, 1922, when the line was established between Moscow and Koenigsberg by Deruluft—The German Russian Airways Company. This was followed shortly thereafter by the Dobrolet or Russian Volunteer Air Fleet; and then by the Ukrvozdukhput or Ukrainian Airline Company. All of this caused the creation of a society known as "Friends of the Air Fleet" which gained 1,000,000 members during its first year. At the start of its second year, this society and that known as the Chemical Society, joined forces to build the now famous Ossoaviakhim with its branches scattered throughout every part of the Soviet Republic; and where they are building miniature museums for collecting models of all types of planes, photographs, posters, paintings and publications for the benefit of the masses who are almost as enthusiastic as the Society's members. The Society has already played a very important part in stimulating the interest in commercial aviation, and has sponsored every notable flight made by the Russian aviators.

The progress of commercial aviation is best illustrated by a few concrete figures of what the Soviets have done and are doing today. In 1927 the commercial planes carried 160,000 kilograms of mail and parcels, or 3.5 times that of 1924. During that same year they transported 7,000 passengers in comparison to 2,618 in 1924 and 4,035 during 1926. For this service the planes made 2,392 trips covering 1,100,000 miles; in addition to which nearly all planes performed more or less service in the dusting of crops with insecticides, spraying 77,000 acres of locust infected fields during the 1927 season. Numerous planes were also used for making photographic records of forest surveys, lands under cultivation, maps, and for checking geographical surveys. In this class of work, the air photographers covered 6,000 square miles of territory during 1927.

The result—today—the Soviets are operating a commercial air line between Moscow, Russia, and Teheran, Persia, with two stops at Mineralnye Vodi and Baku. This service is under the lines of Ukrvozdukhput and is proving very profitable and satisfactory. Dobrolet is operating two lines: one known as the Tashkent-Samarkand-Termez-Dushambe Line, 300 miles in length; and the Verkhnendinsk-Urga (Mongolia) Line of 410 miles. Throughout the 1927 period the planes on these lines had covered 815,000 miles without a single accident. The trip which formerly required seven days by train and motor from Tashkent to Dushambe is now accomplished in six hours. The success of this line caused the Dobrolet to add another line between Frunze and Alma-Ata, and another between Tashkent and Habul in Central Asia. Their newest

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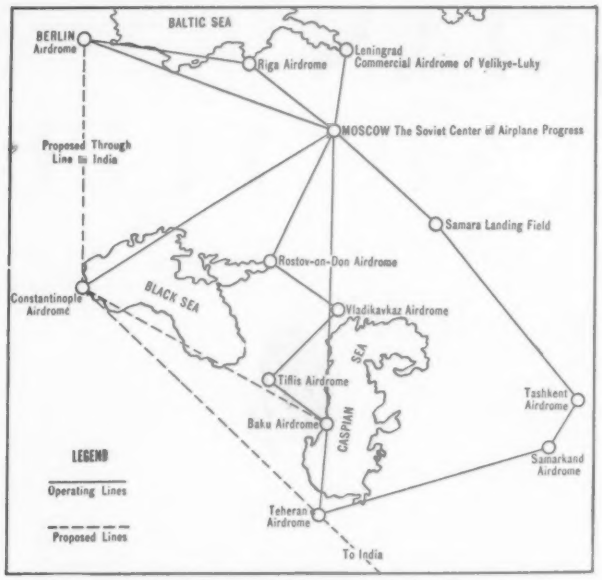

Lines of the Ukrvozdukhput and the Deruluft.

airport is at Irkutsk and from which the planes are now radiating to Mongolia, to Yakutsk with stops at Bodaibo and the Aldan goldfields, and from Irkutsk to Moscow.

The main line of the Ukrvozdukhput is from Moscow to Tiflis, a distance of 3,000 kilometers via Orel, Kharkov, Rostov-on-Don, Mineralnye, Vody, Vladikavkaz, Grozny, Makhatch-Kala, Derbent, and Baku. For this service at present the planes are making daily flights during six months of the year, using Junkers planes. This makes an established direct commercial service from London-Paris-Berlin-Moscow to Teheran, with a branch line from Moscow to Constantinople through Kharkov and Sebastopol. The following chart shows the difference in traveling time required since the advent of the plane service:

From	to City of Destination	Train Time	Air Service
Moscow	Kharkov	21 hours	5 hours
"	Rostov-on-Don	28 "	8.5 "
"	Baku	72 "	32 "
"	Tiflis	114 "	28 "

All air time includes stop-overs on trip.

Special attention is being given at present to the creation of the most perfect landing facilities, and at many of the airports hangars and shops for the repairing and construction of planes are being completed. At present there are eight commercial air ports in the U. S. S. R.—at Moscow, Smolensk, Velikye-Luky (near Leningrad), Kharkov, Rostov-on-Don, Mineralnye, Vody (Caucasus), Vladikavkaz (North Caucasus) and at Baku.

The Dobrolet is a stock company with a paid up capital of 5,000,000 rubles or about $2,500,000. The principal stockholders are the various economic organizations of Soviet Russia. The Ukrvozdukhput was organized in 1923 with an authorized capital of 550,000 rubles which was later increased to 2,000,000 rubles. This company is controlled by the state economic organizations of the R.S.F.S.R and the Ukrainian S.S.R. and the Transcaucasian Republic. The Deruluft is owned by the U. S. S. R. and the German company, "Lufthansa." They started a weekly service in 1922 between Berlin and Moscow which has grown until the planes now make three trips daily through Smolensk or Velikye-Luky, covering 2,000 kilometers on each trip. This line experiences keen competition from the railroads which now operate an express train schedule of 40 hours between Berlin and Moscow. The Deruluft also operates an air line from Moscow, via Leningrad, Reval and Riga to Berlin, with a flying time of ten hours.

Through the society of the Friends of the Air Fleet a tremendous amount of interest was created in the recent contest between aviators flying from Petropavlovsk in Kamchatka to Leningrad, covering a distance of 6,800 miles. This contest was also of tremendous scientific importance to Soviet aviation, a condition which was equally true of the flight of the hydroplane "Soviet North" which made the trip over the Arctic Circle with 16 stops on a flying schedule of 70 flying hours. These stops included Wrangle Island, Nizhne, Kolymsk, Dickson and other points in the Far North.

Among the notable flights which have been sponsored by Friends of the Air Fleet are those in which Russian planes and motors have been used. The first of these was the flight of Gromov who flew from Moscow to Koenigsberg, Berlin, Paris, Vienna, Prague, Warsaw, and thence back to Moscow, a distance of 4,400 miles, in three days. The second flight of importance was that of Moisseev who flew from Teheran, Persian Republic, to Moscow, a distance of 1,950 miles in one day. This was followed by the flight of Mayerup from Moscow to Angora over the Black Sea in an ordinary plane; and by the trip made by six Soviet aviators to the Far East over immense stretches of Siberian taiga, Mongolian deserts, and the Yellow Sea. And the world flight of the "Land of Soviets" plane is too recent to need comment.

On account of the poor railroad and other means of transportation into remote parts of Siberia and Mongolia, and because of the need for accurately charting those immense unknown areas, the future of airplane transportation is exceedingly bright. This is only one of the many units of what Friends of the Air Fleet are ambitious to make the world's greatest air fleet.

At the present time The Dobrolet is

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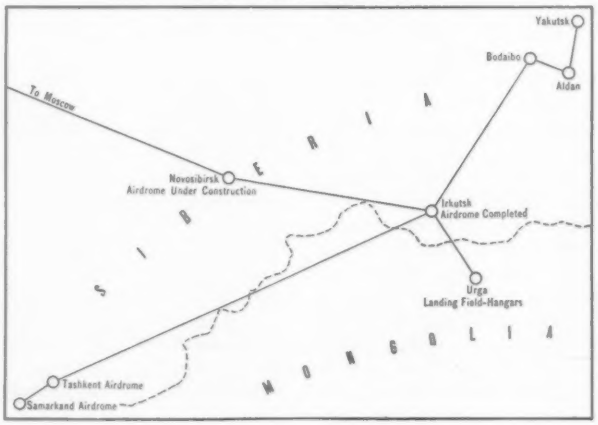
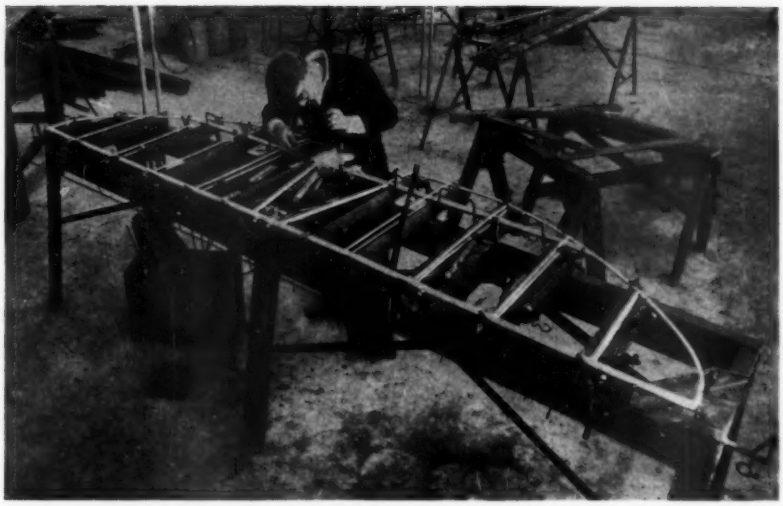
Lines of the Dobrolet.





Welding the horizontal stabilizer over a metal jig. (Waco).

HOW AIRPLANES ARE DESIGNED

by D. R. Lane

AWAY up in the air, so far up it seemed merely a silver gnat against the blue, the little fighting plane twisted and turned, dived, looped and rolled.

"Well," said the lean, brown engineer in a voice of relief, "he's certainly giving her the works!"

It wasn't that the engineering staff had really doubted that their brainchild would be strong enough to stand the strains of aerobatics, or that they cared particularly whether the test pilot handled the plane gently or roughly; the relief came rather from the visible proof that this sturdy little fabric of steel and wood and aluminum, this creature of ingenuity, worry and anxiety, was as good as they had hoped it would be. Now they could take a deep breath and turn to puzzling and studying and worrying over the next design.

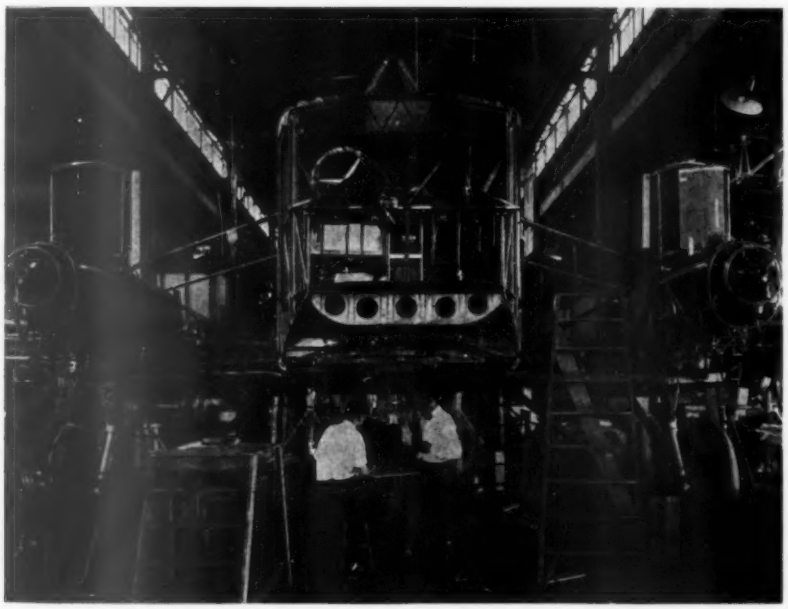
Experience has taught airplane engineers and experts in aerodynamics a great many things, but an airplane is so complex an equation—to borrow a mathematical phrase—and is so full of variables that the acid test of actual performance still is required to confirm the drafting room's conclusions before any new model goes into production.

The little silver plane was coming down now, spiraling steeply. The test pilot widened out the loop of his last spiral, flew out over the water beside the field and glided in smoothly over the cinders. The fast little craft settled easily to a landing. The pilot "blipped" his motor to lift the tail, swung the nose of his plane toward the waiting group of technical men and taxied up to the line. He was grinning as he pulled off his helmet and half-lifted himself from the cockpit the better to talk with the group which quickly gathered beside the ship.

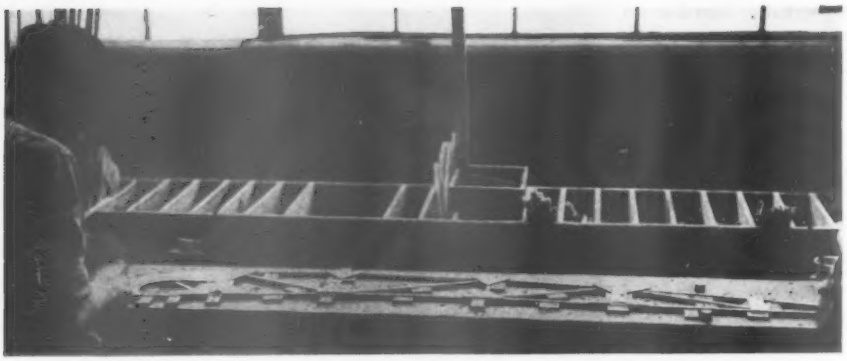
"Well, how about it?" demanded the tall dark chief.

"Mister, she's all airplane!" exclaimed the pilot. "Only thing wrong is she's a little stiff on the aileron. Now . . . . . "

And he's off into a technical dis-



Checking up on the construction details of the Curtiss Condor



Fabricating a wing rib at the Waco factory. Note the manner in which the builder follows the designer's wing section.

cussion of what could be done to reduce the muscular effort required for controlling the plane.

Lucky the engineer whose test pilot makes no more unfavorable report than this at the completion of the first flight. There are so many things in an airplane, any one of which can produce such varied and apparently unrelated results, that the first take-off of a new craft is a very critical period for the entire factory, particularly the designer and the man who is flying it.

Twenty years ago, or even 15, test flights were very different; then there were only three questions to be answered. First, "Will it get off the ground?" Second, "Can it be controlled in the air?" Third, "Will it hold together when it is landed?"

But now design has reached such a stage that unless a new plane is of a very radical type, quite far removed from anything that has been done before, the engineer and all concerned know in advance that the plane will fly, that it will have a certain amount of controllability, and that there is no danger at all of it coming to pieces, even under the severest strains.

Nowadays test flights are to determine whether the plane has sufficient ease of control, whether its stability and maneuverability are so balanced as to fit it for its intended purposes, whether it will attain the top speed required by this model and still fly as slowly as the designer believes necessary, how fast it will climb and how far it will go toward the zenith. Often it is necessary to make flights with several types of propellers and to try out different types and sizes of tail surfaces. Sometimes it is even necessary to experiment with different types of engines. But, in the main, it is possible for the engineering staff to tell months in advance of actual construction just what any particular design of plane will do.

This is true because airplane design, like all other engineering, consists of utilizing the knowledge available from construction of previous planes. Nobody has yet sat down with a slide rule and book of logarithms and figured out by pure mathematics how to build an aircraft.

The whole matter has been one of evolution, just as has all other engineering, a fact which has been lost sight of in connection with other sciences because their basic experimental periods are generally so far in the past. The whole life of aviation, however, has been so brief that its period of trial and error may be said to be still in existence—hence the test pilot; hence also the very lively interest in the test pilot's report.

All this anxiety, of course, could be eliminated were the designers content to build ships which would be no better than those of yesterday; however, for improvement there must be change and so new experiment, new research and new study must be carried on all the time. Yet if the designer were to ignore all precedent, he might as well be back in the pioneer days when the Wrights were flying their early craft as kites and working out the theory of the warping wing. Therefore, in sound design, the engineer's first step is to learn as much as he can of what has already been done with the particular type of airplane he is called upon to build. This enables him to avoid the mistakes that others have made.

Assembling the wing structure.

An airplane is like a ship; it cannot have everything. Weight-carrying ability depends upon the amount of speed required and is also a function of power and wing area which both are closely involved with the speed requirement; the cruising radius depends on the proportion of total load which can be allotted to fuel; the ability to climb depends upon load, wing area, power plant, speed and the cross-section of the airfoil. Stability and maneuverability are interdependent and beside are functions of certain structural variables, such as the grouping of the different weight masses about a certain axis.

To bemuddle the situation further, there are a whole volume of considerations having to do with the various types of construction, and a larger volume concerning first cost, operating costs, cost of maintenance and ease of maintenance. As in an algebraic formula, everything depends on something else.

So, to ascertain which characteristics should be emphasized and which should be suppressed, the designer, when setting out to produce a new aircraft, inquires first as to what demands will be made upon it. Very often he has little information given him except a bald statement of the general purpose for which the plane is to be used.

From this he can draw certain general conclusions. If he is laying out a fighting plane the design must provide for the added weight of a structure sufficiently strong for military service; it must be able to carry the weight of armament; it must provide for maneuverability, and so on. If the new ship is to be a passenger-carrier it

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DIESEL ENGINES

by Willis G. Meyers

THE Otto cycle engine, used universally at present in the aircraft field, has been inherited from the automotive industry, and its initial adoption by the Wright Brothers for flight purposes was due to its representing the lightest known prime mover available for the purpose at that time. Indeed, the same condition still obtains, but there is an ever-increasing amount of dissatisfaction with the limitations of the Otto cycle. This subject, along with that of the advantages of the Diesel engine for purposes of flight, was treated more or less thoroughly by the writer in articles which appeared in the September and October, last, numbers of AERONAUTICS.

While it generally admitted that the advantages of the constant volume oil engine are highly desirable if they are attainable in a service engine suitable for manufacture and use, there is by no means a meeting of minds as regards the question of how close at hand the realization of such an engine actually is by those best qualified to express opinions on the subject. It is a subject, however, that is engaging the attention of leading aircraft and internal combustion engine manufacturers, as well as governmental organizations everywhere.

It is natural, since the Packard organization already has a record of successful test operation in the flight of their Diesel, to be optimistic regarding the future of this type. C. M. Keys, president of the Curtiss-Wright Company, recently was quoted as predicting the use of the Diesel type engine in the aircraft field as a not far distant development.

Perhaps, before going further, a brief review of what has been done to date in developing the Diesel or oil burning engine for the high speed and light weight requirements of aircraft is of interest.

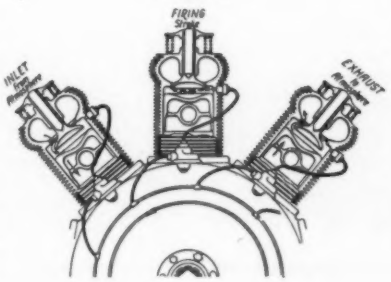
The first Diesel engine, that can properly be placed in the high speed class, was built at St. Petersburg, Russia, in 1909, and was designed for use in a yacht. It was an eight cylinder vee type

A Stinson-Detroiter powered with a Packard Diesel.

engine operating upon the four stroke Diesel cycle. Its cylinder dimensions were 8 by 9 inches, and the power output was 200 b.h.p. at 600 r.p.m., the weight being 4,450 pounds, or 22¼ pounds per horsepower. Fuel injection was by air.

During the war period, a great deal of development work was carried on with a view to adapting the oil engine to submarine work, particularly in England and Germany, and some thought was at that time given also to the possibility of adapting the engine for aircraft purposes, particularly in the latter country.

Transverse section through three cylinders of Packard Diesel radial engine.



Hugo Junkers, in Germany, designed an oil burning engine which had two pistons working in a single cylinder and opposing each other in movement. Recently, Junkers, who will be remembered as the designer and builder of the first heavier than air machine to span the Atlantic from east to west, has completed an eight and also a five cylinder opposed piston engine, and flights of several hours' duration have been reported to have been made with it.

Cross sections of the Junkers engine as developed for automobile work, which is almost identical except as to materials used for the various component parts, to the Junkers aircraft engine, are shown on page 20.

The opposed piston type of oil engine was developed by Prof. Junkers from the Ochelhauser gas engine of similar design but horizontal construction.

The engine is characterized by the following interesting features: Two pistons work in a common cylinder barrel, the lower piston being connected by a short rod to the central crank, the upper piston by two tie rods to two supplementary cranks. Each individual cylinder thus has three cranks without any intermediate bearings. The twin crankshafts geared together to a separate propeller shaft employed in former designs have been done away with.

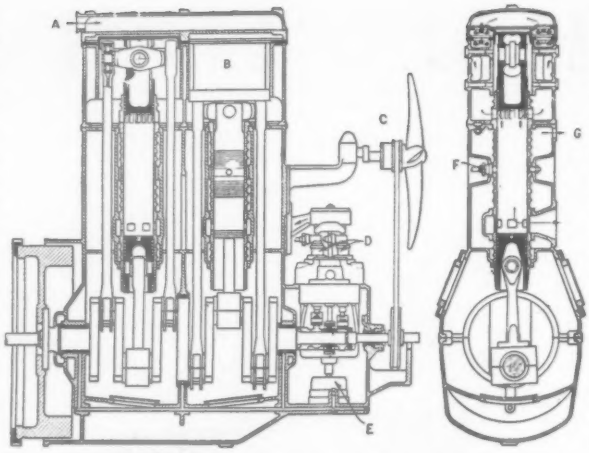
The engine operates on the two stroke cycle. With the two pistons in their inner positions, the fresh charge is then fully compressed, after which the injection, ignition, and combustion of the fuel oil takes place. The resultant increase in pressure forces the pistons apart until each uncovers a series of ports in the cylinder wall and situated around the whole circumference thereof.

While in the original low speed design, the exhaust ports were at the top of the liner and the intake ports at the bottom, the arrangement has been reversed for the high speed type.

The extension of the top piston is

constructed as the scavenge pump plunger, and the pump casing is an integral part of the cylinder cover. The pump capacity is sufficient to provide adequate air supply at the desired pressure.

The cylinder block and crankcase are composed of a one piece integral casting of light alloy, i.e., silumin. The cylinder liners are of steel, in which operate cast iron pistons, the light alloy pistons not having proved satisfactory as yet. The scavenging pump piston is a light alloy casting screwed into the top piston. The cross section is in the shape of a circle with the two segments cut away to leave a width sufficient to allow the scavenge suction and delivery valves to be accommodated within the cylinder cover. The scavenge piston has thus a diameter of 215 mm. and a width across the flats of 100 mm. The clearance volume is 28 per cent. Some independent experiments are recorded in table I. The results show that the actual volume of scavenge and charging air is 1.44 of the displacement of the pistons.



Longitudinal and transverse sections of Junkers two cylinder, two cycle, opposed piston engine.

The crankshaft extension forms the drive for the fuel injection pump and lubricating oil pump. The vertical drive to the safety governor operates, by an additional set of gears, a shaft from which the drive for the water circulating pump is taken off, the engine being watercooled.

It will be recognized that the method of admission and expulsion of the working gases eliminates much of the actuating gear. The balance of the engine is, for all practical purposes, perfect.

Combustion is aided by an almost ideal combustion chamber shape. The ratio of depth to cylinder bore is high—twice as high as that of a single piston engine, which gives a symmetrical chamber with small surface area per unit of volumetric capacity.

It is claimed that the staggering of the scavenge ports introduces such turbulence of the entering volume of air that it continues after the compression of the charge, resulting in a high penetration factor and high combustion efficiency.

The fuel is introduced by direct injection, the pump supplying the correct charge under the proper pressure through a single jet of the open type, as used in several German designs, including the M.A.N. This construction necessitates the pump's being in control of the length of injection and the timing of injection. There is a plunger for each cylinder, complete with its own individual cam. The charge to each cylinder is adjusted according to the load by altering the effective stroke of each pump plunger by means of eccentrics. The control is in the form of the conventional hand lever.

The precision of control of the power and speed has undergone some improvement. In the original design, the merest increase in load would cause the engine to lose considerable revolutions or even to stop altogether. Investigations showed that an important factor in this connection is the relation between the speed and the volumetric efficiency of the fuel pump. It is important to know whether or not the volumetric efficiency of a fuel pump increases with decreasing speed, assuming at the same time the fuel pump or throttle lever remains in the same position.

Since the time of the first report concerning the Junkers engine, interest in heavy oil engines has been constantly on the increase. The Eastern Engineering Co. of Montreal, Canada, built an engine of the two stroke variety in 1925 after the designs of A.C. Attendu. Details of the engine as finally developed, as well as a complete history of the development of the engine, are to be found in vol. 21, part I, p. 207, of the Transactions of the Society of Automotive Engineers.

The development of the oil burning engine in England has been going on for some time. A lengthy report on the prospects of making the heavy oil engine available for aircraft was made to the British Air Ministry by a committee some time ago. In this it was pointed out that the effective weight of the powerplant for an airplane is the weight of the engine plus the weight of the fuel. Any reduction in the weight of fuel necessary for a flight of a given distance can be charged off against any increase in weight of the engine proper. The longer the flight, the more will the higher fuel economy compensate for the increased engine weight. The compression-ignition engine, therefore, can be very favorably compared with the gasoline engine with the latter's weight of two pounds per horsepower. The important factor that enters in at this point is that the Diesel cycle, with its high pressures and high expansion ratio, is able to develop the same power at lower fuel consumption.

An auto-ignition engine, built in England by William Beardmore & Son, is said to have developed one hp.-hr. on .365 lbs. of fuel, which is far better than any results as yet obtained with Otto cycle engines. This engine is similar in all respects to the Beardmore engine for railcars, the chief differences being that aluminum alloy replaces cast steel for the majority of the structural parts and that the engine runs at much higher speed.

Sometime ago, the Westinghouse Electric & Mfg. Co., this country, became interested in the work of the

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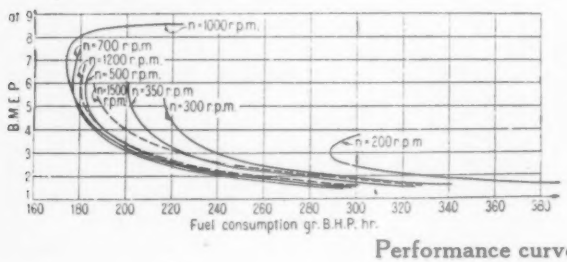
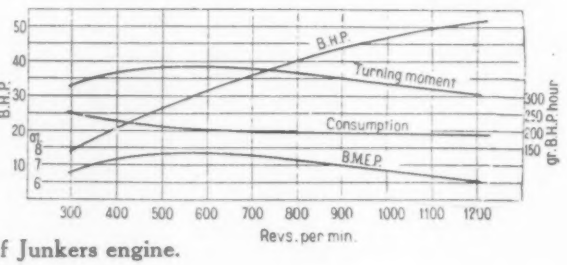
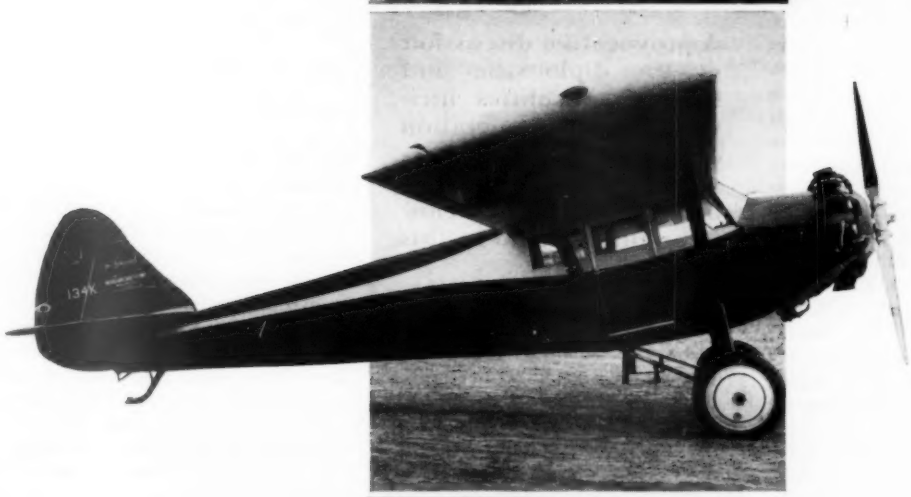




Performance curves of Junkers engine.

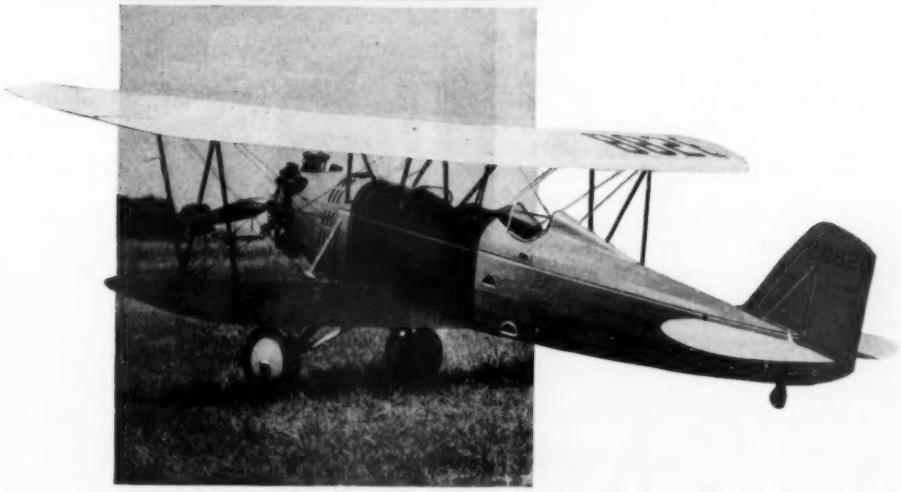
THREE OF THE LATEST

The Laird Speedwing LC-R comes fully equipped with a Wright J-6, 300 H.P. motor, at a price of $11,-500. This ship, holder of many records, offers the flying sportsman a maximum speed of 160 m.p.h., and cruising range of 500 mi. at 125 m.p.h.

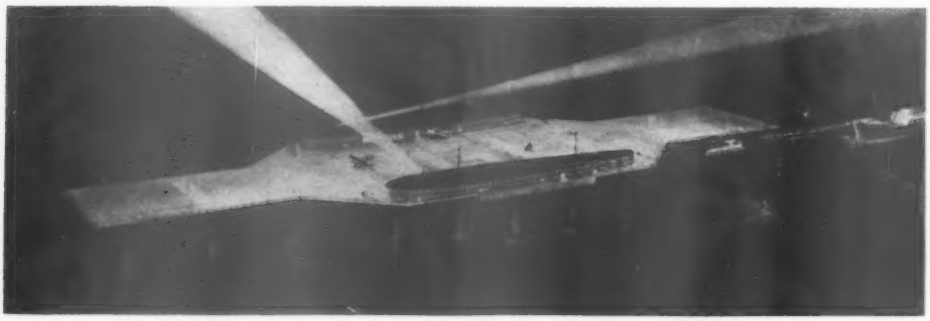


The Monocoach, largest of the Mono line, is a four place dual control job powered with a Wright J-6, seven cylinder engine. High speed of 133 m.p.h., cruising range of 550 mi., 1,200 ft. initial climb, and ceiling of 22,000 ft. Price $8,250.

The Stearman C-3R, 3 place open biplane, powered with a Wright J-6, seven cylinder, 225 H.P. engine. Careful attention has been given to streamlining to increase performance. Features include adjustable stabilizer and fin, removable engine section, and large baggage compartment.



SEADROMES



by Walter Raleigh

A provocative discussion of the diplomatic and legal technicalities incidental to the operation of seadromes. The questions brought up are answered by Mr. Samelow in another article in this issue.

APPARENTLY the diplomats of the world are to be given their hardest problem to solve as a result of man's determination to annihilate distance and obtain speed in travel.

E. R. Armstrong has asked for Government aid in securing technical information that will enable him to place the first of his series of great ocean landing fields in the Atlantic Ocean. The engineering work has already been done in the planning of these great floating islands. Exhaustive tests have been concluded. The final plans have been drawn. All necessary money for the building and operation is assured. Now all that is needed is the help and advice that will indicate the best spot to moor these strange devices. And since official aid has been asked for, Uncle Sam is figuratively scratching his head and his diplomatic chiefs are not so figuratively scratching theirs trying to decide as to how an ocean landing field should be classified.

It seems that Mr. Armstrong, an engineer with aviation experience, and internationally known, has provided the world with a diplomatic problem that will be good for a score of years to come. Whether an ocean landing field, or a "seadrome," as the inventor has named it, is fish, flesh or fowl, belonging to the earth, air or water will only be settled after the holding of national and international parleys and conferences, possibly accompanied with wars and rumors of war. Radio had its early problems, some of which are not yet decided, but a seadrome, being something more tangible than ether waves, is not to be compared with it for giving rise to intricate and complex world questions.

A seadrome, says its inventor, is an airplane landing field moored in the ocean by various devices that will hold it stationary and steady in any kind of weather. The first one is to be placed on the airline between the eastern cities of America and Bermuda. It will provide an exchange station for passenger traffic, for refueling of planes, and later for the hop-off to Europe as well as West Indian islands.

Substructure of the Armstrong Seadrome illustrated above. The 172 foot depth of the supporting structure is designed to prevent rolling and pitching.

The Langley, which is the name chosen for the initial seadrome, will be 1,200 feet long, 200 feet wide at the ends, will rise 80 to 100 feet above the water and will have a draft of 150 feet. a displacement of 30,000 tons, and will cost approximately $1,500,000.

By means of such a craft it will be possible, Mr. Armstrong explained to Secretary of the Navy Adams, to cut the maximum flying range of airplanes between the United States and Bermuda to about 200 miles, and when the seadromes are extended across the ocean, in a series, the airplanes will make the trip by fast and easy hops from one to the other, similar to the methods that have been found so successful in our development of the air-mail service.

Now the United States Navy and the gentlemen of the State Department are not certain as to the exact status of the seadrome. Is the seadrome a vessel and subject to the laws governing ships in ocean travel or is the seadrome an island? Apparently neither answer is wholly right.

Judging by all the rules that have served to govern sea matters since men went to sea, such an ocean landing field cannot be called a vessel. According to the Bureau of Navigation of the Department of Commerce, since the seadrome is not used as a medium of transportation for passengers or freight, they deny its right to be called a vessel. The fact that it will be used as a landing spot for both passengers and freight is, according to these standards, an entirely different matter and well outside of the definition.

Seadromes, not being vessels, are then exempt from provisions of the navigation laws; thus they will not have to

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XUM

Training Glider Pilots

by

Ensign Chester C. Ward

"WHEN an airplane engine 'conks' or is cut off in flight, the plane at that instant becomes a glider, and from then until the ground is reached the safety of the craft and its occupants depends upon the pilot's knowledge of gliding. Only skill and experience in handling his plane as a glider will enable him to make a safe landing." So reasons the Deutsche Luft Hansa, Germany's largest airplane transport company. And on the strength of their belief in glider-plane instruction as an adjunct to motor-plane piloting this company requires all of its pilots to hold a glider-plane license.

Because valuable training in flying may be derived from sail-planing, scores of glider schools have grown up in Europe, and now the science and practice of soaring flight is being taken up in an efficient way by America. On July 29, 1928, Peter Hesselbach soared over the windy shores of Cape Cod, to set the American record for motorless planes at four hours and five minutes, and established the fact that South Welfleet on the Cape was an ideal spot for a glider school. But it was just a few months ago that the school, backed by America's most prominent gliding enthusiasts, was completed and began to train glider-pilots.

At the time of its official opening, the aircraft squadrons of the Navy's Scouting Fleet, then anchored off Newport, R. I., were invited to visit the school. A surprise awaited the 18 naval pilots when they reached South Welfleet.

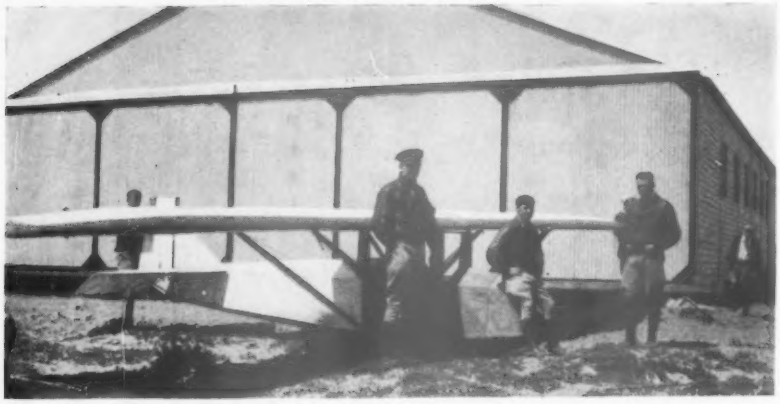
This navy pilot experiences a new sensation in being able to hear the sound of the surf from the air.

Pulling a glider up the sand bank after a successful flight.

There was Lieut. R. S. Barnaby, a naval aviator with 13 years' service to his credit, enrolled as the first student. Subsequently, Lieut. Barnby set the soaring-glider record for Americans by staying aloft 15 minutes.

Perhaps the most impressive thing about the Cape Cod school is the audacity of the students who make initial solo flights almost immediately upon their arrival, though they may never have been in a glider before. A new student attends a lecture on the principles of gliding and watches an instructor make a short demonstration flight. A few minutes later, strapped in an apparently fragile glider, he is projected from the top of a bluff, at the speed of 30 miles an hour. He looks down on the beach, from an altitude of 100 feet, and knows that everything is up to him, for there is no instructor behind him to keep him out of trouble—as there would be in a power plane—nor can he expect help from anyone when he attempts his first landing on the sand which seems to be coming up at him with alarming rapidity.

But he lands safely on the cushioning



A secondary type glider. Lt. Barnaby U.S.N., holder of America's gliding record is shown in the center.

sand, unstraps himself and looks with wonder and affection at the companion of his first flight. It is a primary training-type glider, an open affair with no fabric-covered fuselage. Instead, it has a simple fore and aft framework; the seat from which he has just dismounted is a flat board. In front of it is the joy stick and a horizontal bar which is worked by the feet to control the rudder; below is the landing gear, a simple ski-like skid. Although the glider is sturdily built to insure safety, it weighs only 170 pounds, and the single wing from which the seat is hung is long enough and efficient enough to give the craft a gliding angle of ten to one—which means that it is capable of gliding ten feet horizontally for each foot of loss in altitude.

As the gliding ratio of power planes is between eight to one and ten to one, and since the controls are similar in design and construction in motor and motorless planes, the student has accomplished, on his first flight, the equivalent of landing an airplane from the altitude of 100 feet with the motor entirely cut off. By taking flight instruction in gliders first, anyone who wants to learn to fly can actually get into the air before he has a chance to lose confidence in himself by taking too seriously the trouble-possibilities of a motor.

When the fledgling pilot has had enough practice to enable him to make a straightaway flight of at least 30 seconds duration, he is awarded his first "gull", a device of about three-quarters of an inch in diameter, showing a single sea-gull in flight. It signifies mastery of the primary-type glider.

The intermediate-type glider is the next step in his course. He finds that it has much better flying qualities than he has yet experienced. After becoming sufficiently expert with this craft to sustain flight for more than a minute, and after demonstrating his ability to make well banked right and left turns and good landings, he is awarded the emblem which shows two gulls in flight. The student is now qualified to attain the height of his gliding ambition, for at last he is eligible to pilot real sail-planes —the graceful soaring gliders.

Primary and intermediate glider-types permit only flights in which altitude is lost, but the soaring gliders are such perfect examples of aircraft design that, if the wind currents are favorable, they are capable of attaining great altitudes over the very spot from which they were launched. They have a wing-spread of 50 feet, the wings tapering down so that in flight the glider has the appearance of a gigantic bird. These crafts weigh 310 pounds but the wings and perfectly streamlined fuselages are highly varnished to reduce the air resistance.

The possibilities of the soaring-type glider have been well demonstrated. Consider the flight made by Robert Kronfeld at the tenth international glider contest held recently in Germany. He piloted his ship, the Vienna, a distance of 93 miles and reached a height of 4,400 feet. The endurance record for motorless planes comes as a shock to the imagination. It is sixteen hours; while the altitude mark is set at 9,000 feet. All of the World's records for gliders are at present held by Germans, but the ambitious students at the Cape Cod school are continually striving to bring them to America.

Well may the layman ask: "But what keeps them up?" Strangely, the answer is simple enough. The exceptionally efficient design, the light but strong construction of the craft, in conjunction with the skill of the pilot in using up-currents of air—caused by heat or the broken surface of the terrain—are the factors which permit the establishment of such remarkable records for motorless planes.

When the glider student is able to make a soaring flight of over five minutes, and has completed his ground

[*Continued on page 58*]

A group watching gliding activities at South Welfleet on Cape Cod.

DEVELOPING THE PRIVATE OWNER

by
William S. Brock...

Vice President Schlee-Brock Aircraft Corporation.

THIS is the private flier's year. Now that all the hubbub of manufacturing and merging has died away a little, and the captains and kings of finances have departed to the board room to decide what to do with the dividends, somebody else must take the stage in this fast-moving picture of aviation.

Men who ought to know believe this year is going to be a toss-up between the women and the private flier. Maybe by the end of the year, the news column space allotted to women fliers will be greater than that referring to the private owner, and none of us will complain. The manufacturer and the aviation fan, however, will probably be more interested in the private owner than in the woman stunt flier—if such a thing is possible.

This business of aviation began to hum and go places in 1927, when so many sensational and revealing flights were made. We began to find out what an airplane would really do if venturesome pilots pulled the throttle open and left it there.

Lindbergh, Chamberlain, Maitland, Goebel, Ed Schlee and I, along with scores of others, take some credit for showing capital what aviation promises in the way of a business. It requires very little showing. The whole public was caught up by the possibilities of flying for profit.

Capital stepped in during 1928, and manufacturing of airplanes on something like a quantity basis was started. Many factories sprang up, and not a one of them was without orders for its machines. No real quantity production as we know it in the automobile business was started, but there are a number of airplane factories over this country that would show creditably in a close comparison with automobile plants in production possibilities.

In the latter part of 1928 and in 1929, operations have come to the fore. Mergers of manufacturing interests preceded by a very little time large combines of transportation companies, and today we have five or six great companies with programs that compare with those of great railway systems.

We all remember the hectic time in the spring and early summer of 1929, when every official in aviation was running around with merger in his eye. Nobody who wanted to sell went without an offer. The few strong, independent companies were besieged with offers to join many combines.

All of this had its effect on the public. When the names of well-known bankers and capitalists began to appear in the aviation news columns, people began to think that maybe there is something in that old saying that "flying is safe," and more people began to use the airplane.

The average airplane passenger is disappointed during his first ride. He has looked at airplanes for so long as instruments of death and agents of excitement, that the smooth rapid flight, ending with a simple landing, fails to meet his expectations of a hair-raising experience. Many such passengers easily convince themselves that actually piloting a plane promises the only real thrill in aviation.

As vice-president of the Schlee-Brock Aircraft Corporation, I have been making some observations on the private owner. He has been growing in numbers and all indications are that he will soon take his place in the sun.

The increasing enrollment in flying schools is one important indication of this new day. Not all the students in flying schools are preparing themselves for jobs in aviation. The increasing percentage of young men in flying schools who are financially able to indulge in some of the more expensive sports like yachting and polo, augurs well for the presence of wealthy men among private plane owners.

The aviation country club idea, built almost solely on the idea of private owners' who enjoy the sport of flying, is being accepted in almost every community in the country. This is an excellent evangelistic effort for aviation in a direction where it will pay rewards to those who are developing the game.

Bankers have not limited their aviation experiences to investments. One finds them riding the airlines in numbers, and more and more of them are buying their own planes.

More airports are going to be necessary for these private owners. Municipal airports are going to be so crowded in a few years, perhaps before the end of this year, that they will have to be limited to commercial flying. There is an opportunity now in every sizeable American community for a privately-owned and operated field catering to the needs of the private flier.

The faster these airports are placed in

[*Continued on page 92*]

Aeronautics

Warren Irving Glover
Adviser on Air Mail

J. Don Alexander
Adviser on Dealer's Sales

Sherman Mills Fairchild
Adviser on Aerial Photography

B. Russell Shaw
Adviser on Airports

Alexander Klemin
Adviser on Aerodynamics and Structures

R.J. Goodman-Crouch
Adviser on Engineering

ADVISORY BOARD

We are privileged to present to our readers the members of AERONAUTICS Advisory Board.

Each Adviser is an authority on some phase of aeronautics and has consented to lend his services in the interests of the promotion of aviation. The advice and opinions of these men, which is now made available to our readers, provide a reference service that will be of inestimable value.

Further particulars about this Board, and a brief sketch of each member will be found on page 11.

Charles Sherman Jones
Adviser on Flying Schools

Louis Bleriot
Adviser on French Activities

Archibald Black
Adviser on Transportation

Henry Joseph Cox
Adviser on Meteorology

Lady Heath
Adviser on Women's Activities

NEW EXPERIMENTAL PARACHUTES

by G. H. Dacy

COMPREHENSIVE experimentation with parachutes of revised and improved design at Wright Field near Dayton, Ohio, promises to add increased safety to essential leaps from skyland.

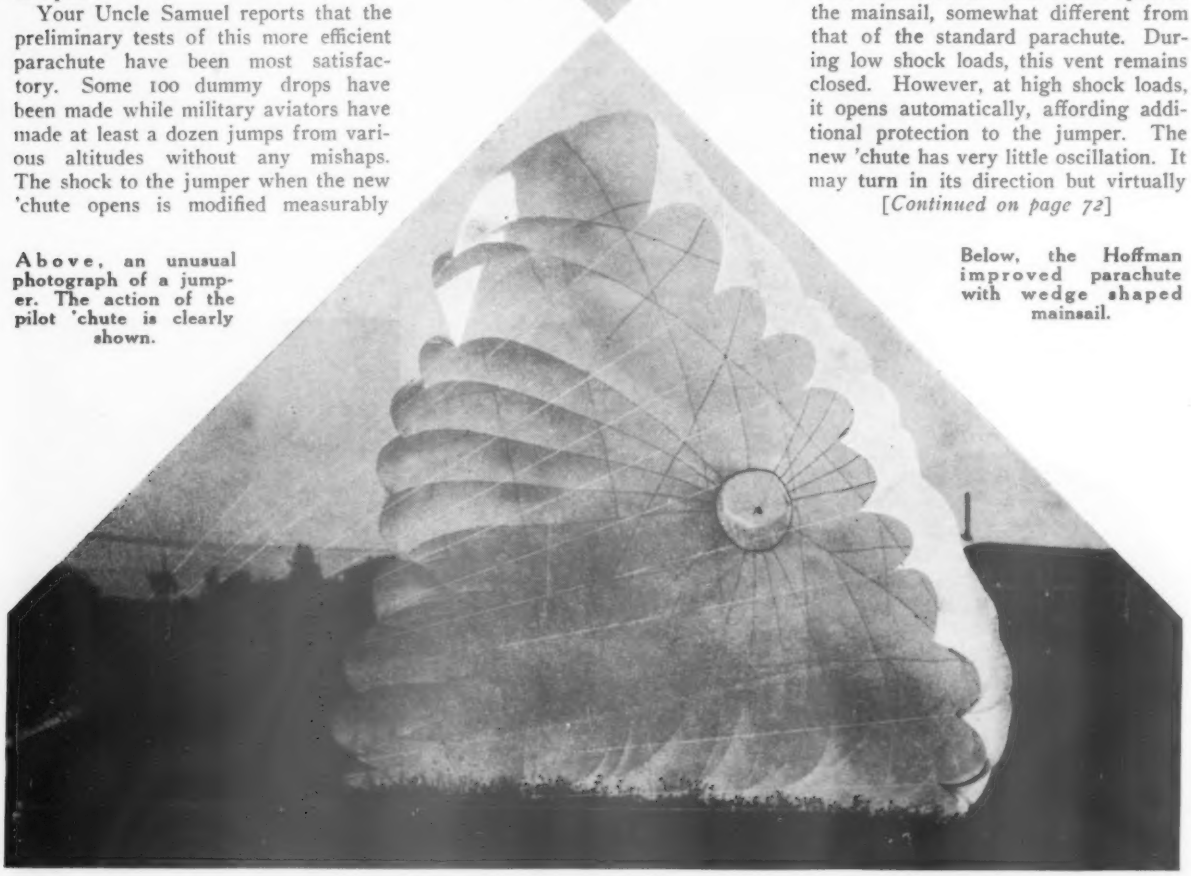
Research experts of the Army Air Corps under the direction of Major E. L. Hoffman have substituted a triangular mainsail for the circular one formerly used as regulation equipment on a standard 'chute. The new wedgelike mainsail is rounded at two corners while the third is sheared straight across. The shroud lines extend down, being spaced regularly as in the official parachute except across the sheared off corner which has no shroud lines attached. When the improved 'chute is open this portion upon which there are no shroud lines to pull forms a tail-like vent through which the air escapes.

Your Uncle Samuel reports that the preliminary tests of this more efficient parachute have been most satisfactory. Some 100 dummy drops have been made while military aviators have made at least a dozen jumps from various altitudes without any mishaps. The shock to the jumper when the new 'chute opens is modified measurably over previous conditions while it affords greater manual steerability in the descent from the clouds. These improvements have been consummated chiefly as a result of the radical changes in the shape of the mainsail. The air which escapes through the tail-like vents propels the parachute horizontally at a speed of from 3 to 4 miles an hour. Because the 'chute inherently possesses this horizontal motion, steering can be accomplished by the adept manipulation of the shroud lines. This means that the parachute can be so turned that the vent is either with or against the wind, thus controlling the direction of the falling birdman's cruise from the upper atmosphere to terra firma.

The diminution in shock to the parachute jumper who uses one of these new 'chutes results from the efficiency of a second round vent at the apex of the mainsail, somewhat different from that of the standard parachute. During low shock loads, this vent remains closed. However, at high shock loads, it opens automatically, affording additional protection to the jumper. The new 'chute has very little oscillation. It may turn in its direction but virtually

[*Continued on page 72*]

Above, an unusual photograph of a jumper. The action of the pilot 'chute is clearly shown.



Below, the Hoffman improved parachute with wedge shaped mainsail.

A close-up of sugar cane in the Everglades shows clearly why it is easier to inspect the fields from the air.

RAISING CANE IN FLORIDA

by Bror Gustave Dahlberg*

SOARING over vast stretches of the Florida Everglades, the airplane today is playing an important role in the development of that enormous and until five years ago useless portion of the United States.

Back in 1920 a party of motorists, hunters and thrill seekers drove a couple of badly battered automobiles through the Everglades' swamps from Fort Myers, a village on the west coast of Florida, to Miami, then merely a small resort town on the east coast. The journey, a matter of some 140 miles, took them two or three weeks. To say they "drove" is speaking figuratively; in reality they pushed and pulled the automobiles over the greater part of the distance.

That was ten years ago. Today, a little Curtiss Challenger Robin cabin monoplane, one of the same brood as the famous St. Louis Robin, takes off from a perfectly groomed landing field in the heart of this same Everglades and cruises above a 50-mile stretch of some of the most productive land in the world. From its cabin, officials and experts view the planting and growth of thousands of acres of sugar cane on the 160,000 acre property of The Southern Sugar Company. An airplane is the only piece of modern machinery that can make this task speedy and effectual.

To present a conception of the part played by the airplane, it is necessary to tell something of the history of this development. In 1925, after an intensive survey of undeveloped areas in which sugar cane might possibly be grown successfully, my associates and I decided the Everglades was the best location for the establishment of sugar cane plantations in the United States and possibly the world. Department of Agriculture sugar experts said the soil was peculiarly suited to growing cane, if it could be properly drained, irrigated and protected from occasional high waters in Lake Okeechobee.

From experiences in reviving cane

*Mr. Dahlberg is president of Celotex Company, Dahlberg & Co., Clewiston Co., Inc., Southern Sugar Co., South Coast Co., Dahlberg Corp. of America, Florida Sugar Co., Cypremort Co., and is responsible for much of the reclamation work done in the Florida Everglades.

XUM

production in Louisiana through the importation of the sturdy P.O.J. canes from Java, we felt certain the raising of the cane was not a difficult task in itself. My engineers said the drainage and irrigation work could be done on an economically sound basis. So The Southern Sugar Company was formed and some 90,000 acres of Everglades land purchased along the southern shore of Lake Okeechobee. Work was started. Levees of proper height and construction were built; some 130 miles of drainage canals and lateral ditches were dug and pumps of enormous capacity, adequate for every emergency, were installed.

During the winter of 1926-27, 700 acres were planted in cane, which grew to enormous size and showed an unusually high sugar content of remarkable purity. In 1927-28 some 5,000 acres were planted and in 1929 more than 12,000 additional acres were placed under cultivation. During this time the holdings of the company were increased to more than 160,000 acres. Over this area the work of draining and preparing the soil for cane planting is constantly in progress.

Early in 1929 the extensiveness of the territory in various phases of development made it increasingly difficult for officials of the company to check the progress of the work. For nearly two years I had been using airplanes for business purposes. First in a Stinson-Detroiter and then in a Fairchild cabin plane, I had flown some 200,000 miles. So it was not unnatural that a plane seemed to me the logical solution of the problem of checking work in the Everglades.

The Southern Sugar Company purchased for delivery in May, 1929, the cabin monoplane. The plane was ordered primarily for inspection work but it has since proven its value as a transport medium for company officials making hurried business trips to New York, Chicago and cities in Florida.

The plane is housed in its own hangar at the only municipal airport in the Everglades region. The airport is part of Clewiston, the town of 2,000 inhabitants which has arisen around the mills that grind the Everglades-produced cane.

From this landing field, the plane, piloted by Neil Stewart, a flyer with 2,000 hours behind him in the air, daily carries on the routine work of inspection of crop growth and drainage work. In the first five months of operation, the plane was in the air more than 250 hours, most of which was devoted to inspection work.

A sugar mill in the Everglades surrounded by a vast expanse of sugar fields.

Speed and ease of watching progress on the far-flung points of the company's holdings is the essence of the craft's usefulness. A survey of the growth of the entire area planted in cane can be made in a few hours from the air. In the old plantation days, a horseman would have plodded wearily mile after mile through the fields of cane, dismounting occasionally to inspect between the rows. A week would be necessary to duplicate an hour's plane trip. With an automobile, no better time could be made, and in places the car would be inferior even to the horse.

In order to inspect properly the cane planting operations and to appreciate the condition of the cane fields from the ground, it is not only necessary to travel through the fields but also within the fields between the rows. The huge stalks of cane, growing far above the head of the tallest man, make it impossible to inspect more than two rows at a time on foot.

From a plane traveling at an altitude of from 600 to 800 feet, it is possible to see and appreciate the exact condition of the cane not only more quickly but more perfectly than is possible from the ground. Officials of the company say they can inspect more work in one hour's flight aboard the plane than they could by a week's constant traveling on the ground.

Recently a visiting official of another company made an extensive trip over the properties. He was immediately impressed, not only with the desirability of having a plane for inspection work, but the necessity of having one to supervise the myriad details of his own extensive undertaking. This company, I understand, has since placed an order for a similar plane to watch crop progress.

The value of having the plane at the disposal of company officials was demonstrated last July on a flight made by P. G. Bishop, operating vice-president of the company. In the midst of important development work it was necessary for him to attend a directors' meeting in Chicago. Boarding the plane at Clewiston, Mr. Bishop was landed at the Municipal Airport at Chicago the same night by Pilot Stewart. The next morning he attended the directors' meeting. In the afternoon he returned to the air port, flew to Evansville, Ind., where he spent the night, and the next afternoon was back in Clewiston. Three days away from his work. If he had used the trains he would have been away five.

Of course this advantageous use of the airplane in the first great agricultural project in Florida's Everglades is merely one instance of the many private commercial and industrial uses to which aircraft can be put. But to me it seems particularly fitting that the plane should find its place in this development beside modern planting and harvesting machinery, modern engineering and modern scientific agriculture, all of which have had a share in making this new American "sugar bowl" possible.

INFORMATION

We cordially invite our readers to make use of the various advisory and information services offered by Aeronautics. Data on planes, equipment, investments, etc., are available upon request.

A LESSON IN STUNTING

by Rodney H. Jackson

LIVES there a pilot who has not looped or spun? Impossible to believe, for one of the most characteristic points about the pilot with ten or twenty hours in the air is his eagerness to cut hi-jinks whenever he spreads his new-grown wings.

Violent and complicated stunts, however, have no place today in commercial aviation, and a pilot who flies for a living generally settles down, for the sake of his reputation, to straight and sane flying, with an occasional wing-over or flipper turn to enliven an otherwise dull routine. Stunting, except for the elementary spins and loops given by the flying schools, is more and more becoming the special prerogative of Army and Navy service pilots.

I have been on active duty with the squadrons of the Battle Fleet for almost a year, but only last week did I rediscover the joy of stunting. As a fledgling a few years ago I remember attempting all sorts of wild and impossible stunts, carefully out of sight of the Naval Reserve base, from Jenny Immelmans to flying an NY on its back, or rolling an ancient N-9. Now, after eleven months of Vought "Corsairs" and Loening Amphibians, I have flown a "fighter." As the gunnery year draws to a close and officers take their annual leave or transfer from one squadron to another, many planes on North Island are left temporarily idle, and a little judicious promoting may pay big dividends.

Col. Lindbergh leading the Three Musketeers in a feature event at the National Air Races.

Below, Al Wilson stunting before the grandstand in an illuminated plane.

For a week I have been deserting my own squadron to fly Boeing single-seaters, borrowed from Reserve officer friends in VF-1, VB-1, and VB-2, and for a week I have been trying almost everything under the sun. I have been thrilling to scores of new experiences, new after 600 hours in the air, as I "wished" my "Wasp"-powered craft through the atmosphere.

One morning I spent looping. Now in an ordinary airplane a loop is a loop, done with a slight dive, full gun, and often a falling sensation as you go over the hump. But in a Boeing, you can loop to order—at 100, or 150, or 200 miles an hour, a small loop, or a fat one, a tall loop or a wide one. Or you can change your mind at the top and half-roll to make it an Immelman, or you can just shove the stick forward and float along upside down!

A cartwheel is fun, too. You are in a steep left turn—just step on your right rudder pedal hard and fast, and a second later you find yourself in a right flipper turn. Or, when you get tired of that, try a whip-stall or a snap-loop. With plenty of speed pull

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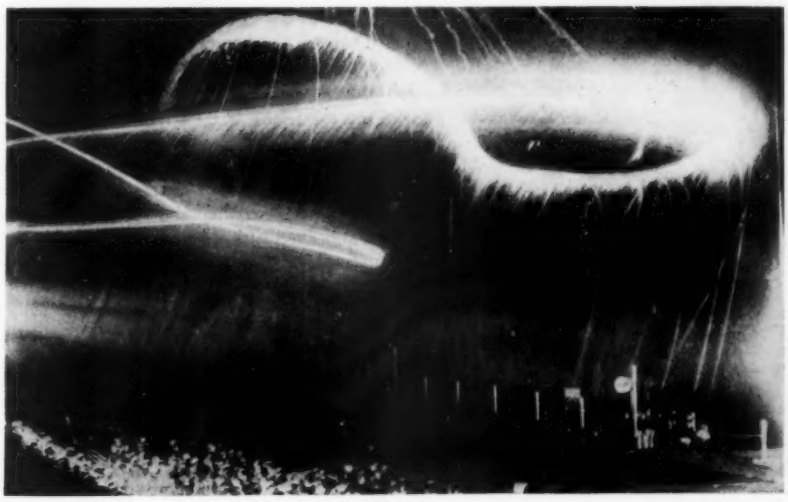

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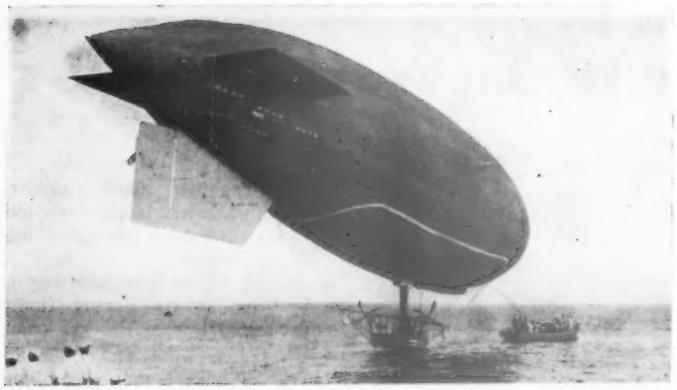


The D-N-1, the first Navy Dirigible.

by
Frank
Wilber
Wead*

An early type captive balloon attached to the U.S.S. Huntington.

CREDIT for the first recognized lighter-than-air experiments is given to Roger Bacon, a thirteenth century friar, who attempted to solve the problem by exhausting the air from a large, thin copper sphere. He failed as did Francis Lana, a Jesuit, who in 1670 tried the same idea on a larger scale.

Cavendish's discovery of hydrogen in 1766 made possible the future and present development of lighter-than-air craft, although the Montgolfier brothers in 1771 began the study of hot air balloons and in 1773 sent aloft a 300-pound, 22-000-cubic foot paper balloon to a height of one mile. Later the same year they used hydrogen for an ascension at Versailles, carrying a sheep. And in November, 1773, they directed the first man-carrying ascension, in which the Marquis d'Arlandes and the Pilatre de Rosier made a flight in a hot air balloon. Two years later, in 1775, Jefferies and Blanchard ballooned across the English Channel, from Dover to Artois. Eight years later, Blanchard made the first confirmed balloon flight in the United States, at Philadelphia.

Once the practicability of flight had been demonstrated, early balloonists at once turned their efforts towards control and propulsion, in order that they might navigate the air regardless of the wind. Sails were tried and found to be useless. In 1784 Blanchard, Meusnier, and M. Charles and Robert all tried oars for propulsion and steering, but this proved to be virtually worthless. In 1850 Henry Giffard built a small cigar-shaped balloon powered with a 3 h.p. steam engine fitted with a screw propeller, which attained a speed of 5 miles per hour.

In 1872 Haenlein built an unsuccessful dirigible powered with a gas engine which brought the ultimate success of this type considerably nearer. In 1883 Tissandier's balloon, driven by an electric motor and batteries, made a successful flight but failed to return to its starting point. In 1884 M. Krebs and Renard with a similar electric drive achieved the first real success by making a circular flight at speeds of from 6 to 14 m.p.h.

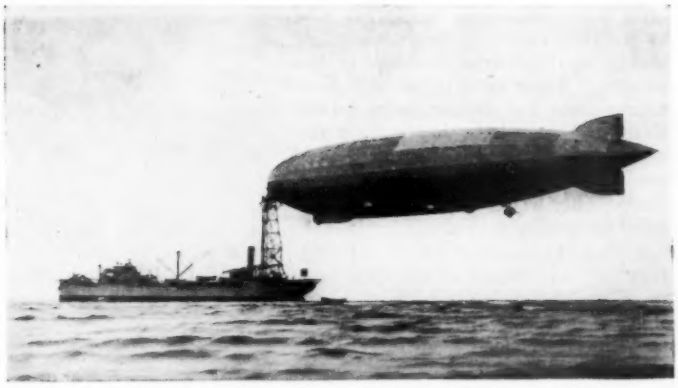
In 1894 Count Zeppelin first considered the problem. He employed two engineers in 1898 and made his first flight on July 2, 1900, at a top speed of 17 m.p.h. in a rigid airship.

Albertō Santos-Dumont also had been experimenting and on October 19, 1901, his non-rigid blimp flew around the Eiffel tower and won a prize of 100,000 francs. In November, 1903, a Lebaudy semi-rigid flew 60 miles in two and three-quarter hours at a speed of 22 m.p.h. and was subsequently wrecked by collision with some trees. Between 1803 and 1910 a variety of non-rigids, semi-rigids (equipped with a longitudinal keel for strength) and rigids were evolved, all of which aided in the development of lighter-than-air craft. France had the Clement-Bayard and Santos-Dumont non-rigids, the Republique, the Lebaudy mentioned above and the rigid Astra-Torres. Germany had the Zeppelins and the Parseval non-rigids and, later, rigids, and in 1908 the Schutte-Lanz Company produced a rigid of improved design and performance. England built her first dirigible, the Mayfly, in 1911. In the United States a Baldwin non-rigid was sold to the Signal Corps in 1908, having a lift capacity of some 1,500 lbs. and a

*Lt. Cdr. Wead U.S.N. graduated from Annapolis in 1916, commanded the U.S. Navy Schneider Cup Team in 1923, and in 1924 with Lt. J. D. Price broke five world's records in a single flight with a CS-2 seaplane.

THAN AIR

An interesting review of lighter than air achievements, climaxed recently by the successful flight of the R 101.



The Los Angeles moored to the U.S.S. Patoka.

speed of 20 m.p.h. In 1910 Wellman attempted to fly the Atlantic in his dirigible, being dragged down by a fouled sea-drag rope after flying some distance, and Vaniman's Akron was destroyed at Atlantic City in 1912 when preparing for a similar attempt.

Inasmuch as the Zeppelins led the world in rigid airship construction before and during the war, and also because American and British dirigibles have been largely based upon their designs, it is proposed to follow Zeppelin history in some detail.

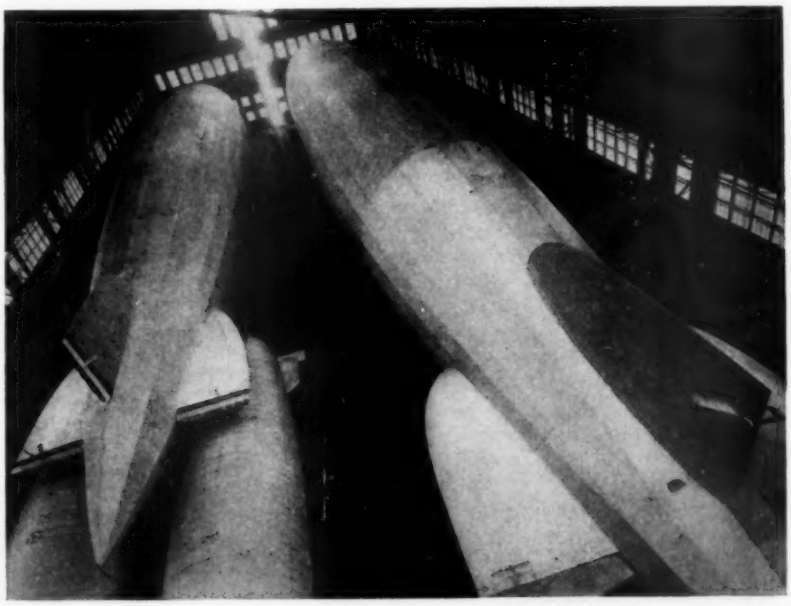
Count Zeppelin's first ship, referred to above, was dismantled after a few flights owing to lack of funds. His second, completed in 1905, had two 85 h.p. engines and a ceiling of 2,000 feet. It was wrecked in a winter storm. The L-3, with a very complicated tail, was finished in 1906, and in 1907 made a record 8-hour flight of 218 miles at 29 m.p.h. The German government then promised to back Zeppelin if he could produce a ship capable of a 24-hour flight. In 1908 the L-4 was accordingly brought out, with a capacity of 530,000 cubic feet and two 100 h.p. engines. It flew over the Alps from Friedrichshafen to Lucerne and return, but was burned in August.

The German people were so enthused by Zeppelin's progress that they raised $1,500,000 by popular subscription to enable him to continue his work. In 1908 the Schutte-Lanz Company produced an excellent dirigible with a capacity of 724,000 cubic feet, 430 feet long, two 250 h.p. engines and a speed of 42 m.p.h. The L-5 and L-6, Zeppelin's next designs, also functioned efficiently. The use of duralumin after 1910 decreased weight without loss of strength. Goldbeaters' skin for gas cells lessened diffusion and increased efficiency. The elongated form became better streamlined and the monoplane tail was adopted as standard.

In 1910 the German Airship Transportation Company, popularly known as the Delag, was organized by Zeppelin by 1914 had carried 37,250 passengers on 1,600 flights, for a total of 3,200 hours in the air and a total distance of 90,000 miles. Commercial airports were in use at Baden-Baden, Frankfort, Dusseldorf, Johannisthal, Gotha, Hamburg, Leipzig and Dresden, and the airships, Deutschland, LZ-6, Schwaben, Victoria-Louise, Hansa and Sachson, had been built by the plants at Friedrichshafen and Potsdam and were in regular service. Thus grew the nucleus of Germany's wartime Zeppelin fleet. In 1915 the assets of the Schutte-Lanz and Zeppelin works were combined and the advantages of both types of construction were amalgamated into the super-Zeppelin type thereafter produced.

When the war broke out there were 11 rigid airships in Germany. Of these six were allotted to the Army, two to the Navy and three were considered fit for commercial use only. None of them were designed or well fitted for war. They were heavy, slow, had a low ceiling, were easy targets for ground fire, and the bombs available were utterly

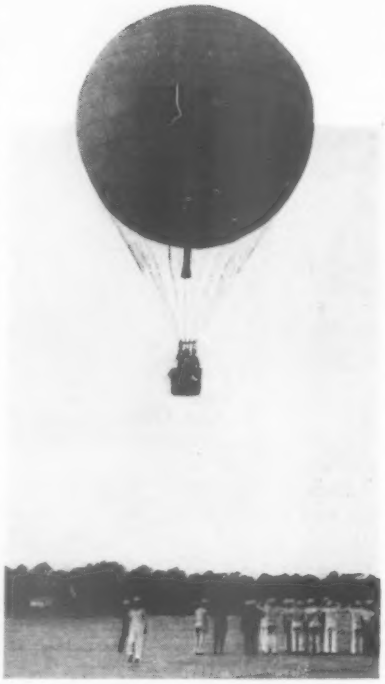
The Los Angeles acting as host to the Graf Zeppelin at its hangar in Lakehurst.



inadequate. Their first task was to cooperate with the German Army by bombing and observation on the Western front. They considerably hindered the Belgian retreat from Antwerp and frequently sent back information of value to the German ground forces. One by one they were shot down, burned, or broken up by forced landings in bad weather. Later an attempt was made to use them for similar duties on the Eastern front, where they made a few successful scouting flights and bombed some railroad junctions and ammunition dumps. They were hampered by cold and snow and Petrograd was too far from the lines to make successful raids against it feasible. As a result of this experience the Germans decided that the rigid airship was primarily a Naval weapon, better suited for over-sea operations, and hence all Zeppelins, including the 88 constructed during the war, became a part of the German Naval Air Service.

The first Zeppelin raid on England was directed against Yarmouth in January, 1915. In May, 1915, the first attempt to bomb London was frustrated by clouds and fog and the Germans deposited their load on Harwich instead. From this time on Zeppelin raids on London steadily increased in regularity and strength, soon becoming one of the outstanding and most spectacular features of the war. In addition Zeppelins operated from Jamboli and Bucharest, scouting the Black Sea and Greek areas, and conducting bombing raids against Naples and Saloniki.

In July, 1917, the LZ-120 carried out a patrol of 101 hours over the North Sea. In August, 1917, an English cruiser launched a plane which shot down the L-23 off Denmark. In November, 1917, the L-59 started to carry badly needed supplies to German forces in Africa. While en route word was received that the German forces had surrendered and the airship was ordered home by radio. It returned successfully after flying 4,230 miles in 95 hours.



A Free Balloon weighing off.

During almost every hour of the war a Zeppelin was on patrol over the North Sea, reporting movements of the English Fleet, spotting and bombing submarines, locating mine barrages, and patrolling the Baltic against the Russian Fleet and contraband commerce. In April, 1917, the L-23 dropped a bomb in front of the Norwegian bark, Royal, causing it to heave to, landed on the water, put a prize crew on board and sailed the captured ship into Cuxhaven.

The performance of the Zeppelins at Jutland has been the subject of much controversy. Admiral Scheer had long planned to use the Naval Airship Service in furthering the success of the German High Seas Fleet. In May, 1916, he planned to raid Sunderland on the English Coast, using Zeppelins to keep him informed of the whereabouts of the British sea forces. The weather was such that the Zeppelins could not leave their hangars so Scheer abandoned the proposed raid and took the Fleet on a sweep up through the Skaggerack. The Fleet sailed at 5 a.m., May 31. Despite bad weather the L-16 and L-21 left their hangars at 1 p.m. and the L-9, L-14 and L-23 left for the Helgoland area at 2 p.m. The battle took place during the late afternoon, evening and night of May 31. No Zeppelin made contact with the British forces prior to the battle or sent in any positive information of value. Their presence, however, assured Scheer that his left flank was clear and enabled him to carry on with the assurance that escape was always possible. During the night of May 31-June 1, the Zeppelins L-11, L-24, L-13, L-17, and L-22 left their sheds and at daylight located the principal elements of the British Fleet. Scheer's escape was by this time assured, but these reports undoubtedly relieved his mind. In August, Admiral Scheer again tried his Sunderland plan with eight dirigibles. Certain British units were sighted, but the Zeppelins were spaced 100 miles apart, the visibility was not good, and the British main body slipped through a gap in the line, and so another great sea battle—perhaps the greatest—was never fought. Zeppelins materially aided the escape of the German cruisers in the action off Yarmouth and assisted in sinking the Nottingham and Falmouth.

From the somewhat varying sources of information available it is concluded that, during the World War, Germany made 51 airship and 52 airplane bombing raids on Great Britain, killing 1,413 persons, wounding 3,408; that in London alone, which was the objective of most of these attacks, 524 were killed, 1,264 wounded, and property was damaged in excess of $10,000,000. In addition the morale of factory workers

[*Continued on page 54*]

The Graf Zeppelin over Chicago's skyline.

THE DANIEL GUGGENHEIM FUND

A review of the work done for the promotion of aeronautics during the official life of the Fund. This article was prepared by a staff correspondent with the assistance and generous cooperation of the officials in charge.

ON December third, last, a New York City newspaper printed a small, simple article announcing the fact that the Daniel Guggenheim Fund for the Promotion of Aeronautics, Inc., would end its official existence on Dec. 31, 1929. A simple item to the people of perhaps a decade back, but one of considerable importance to the now "air-educated" public. What the Fund has accomplished in its four years of existence will probably never be equalled in a like cause. Aeronautics, in general, has benefited through the activities of the Guggenheim Foundation, and Aviation, in particular, owes an enormous debt which it will not be allowed to forget for generations, if at all.

Founded in January, 1926, with deeds of gift from the generous philanthropist, Daniel Guggenheim, amounting to $2,500,000, on which total sum interest and principal could be expended, the purpose of organization was expressed in a letter addressed to Herbert Hoover, at that time Secretary of Commerce, bearing the signature of Daniel Guggenheim, unpretentiously Mr. Guggenheim, senior, stressed the importance of "how can the civilian use of aircraft be promoted" continuing and explaining the natural resources, industrial organizations, and the long distances free from customs barriers, with which this country was equipped.

The then new fund, as explained to Mr. Hoover, was to be administered by a Board of Trustees composed of men of eminence and competence and was to be devoted to promote aeronautical education both in institutions of learning (the first being the School of Aeronautics at the New York University), to assist in the extension of fundamental aeronautical science, to assist in the development of commercial aircraft and aircraft equipment and to further the application of aircraft in business, industry and other economic and social activities of the nation. All of these theoretical prophesies being absolutely restricted from interfering with any project which was properly a government function.

Captain Emory S. Land, executive vice-president and treasurer of the Fund.

This letter was, of course, acknowledged by the then Secretary of Commerce, Herbert Hoover, who stated in his acknowledging letter, "Knowing as I do the great field for scientific research in the physical forces which underlie this most promising development in civilization, I necessarily welcome so fine a gift for its advancement."

The charter members of the Board of Directors for the Guggenheim Fund included F. Trubee Davison, Hutchinson I. Cone, Harry F. Guggenheim, Dwight W. Morrow, Elihu Root, Jr. and John D. Ryan. Immediately after the Certificate of Incorporation was filed the following were added to the Board: William F. Durand, George W. Goethals, A. A. Michelson and Orville Wright.

The first few months of the Fund's activities was made up largely of investigating the possibilities of airline routes, which, of necessity, at the time made it necessary to initiate passenger air transport by making large equipment loans to commercial air companies and to organize such tours as were undertaken, at the Fund's request, by Colonel Charles A. Lindbergh in 1927 and Floyd Bennett, late, who flew in Commander Byrd's (who now bears the honorary rank of retired Rear Admiral of the United States Navy) North Pole Plane in 1926. The extraordinary, but yet natural, amount of public interest in Aviation and the capability of air transport companies to promote all their needed capital through independent sources, caused the Fund to revise their original plans and in early 1928, it devoted its energies in the channels of scientific research. The first of this work consisted in the donating of $1,200,000 to five great engineering universities for causes of research, these being the California Institute of Technology, the Massachusetts Institute of Technology, Stanford University, University of Michigan and the University of Washington.

In the year of 1928, several changes were found in the Fund proper and its activities. Several items of importance were listed in a report issued at that time. Principally, the personnel was changed to the extent of Capt. Emory S. Land, Construction Corps, U. S. N., to replace Rear Admiral Hutchinson I. Cone, who was appointed to the Shipping Board of the United States by ex-president Coolidge as executive vice-president and treasurer. Harry F. Guggenheim, son of the Daniel Guggenheim who founded the Fund, and who has recently been appointed United States Ambassador to Cuba, was seated in the chair of president and Maj. General George W. Goethals, trustee and friend of the Fund, was lost to the country.

In its activities the following had already been initiated: Concentration of scientific problems involved in the mechanical structure of the airplane; the study of environmental conditions necessary for safe operation, particularly meteorology and the problem of fog-flying, the most dangerous barrier, at present, to safe operation and dependable activity; and the organization of the Safe Aircraft Competition.

Pamphlets of keen importance were

issued at the Fund's expense covering all phases of aeronautics both ground and flying; $40,000 was appropriated for Dr. William F. Durand for a complete study and encyclopædic treatment of that part of aeronautical science represented under the title, "Aerodynamic theory and the experimental data thereto"; close co-operation was given to daily newspapers, much credit for which is due Milburn Kusterer, the journalistic genius of the Fund. These and other indications of increasing interest and the trend of the laymen to aeronautical knowledge were interesting exhibits of the popularity and necessity for such a Fund with such a backing and with such capable leadership.

In the fall of 1927 the Guggenheim Foundation succeeded in organizing a National Conference on Safety in Aeronautics, which was taken under the wing jointly by the Fund and the National Safety Council. The Conference lasted two days on October 4 and 5, 1927, as a regular part of the 17th Annual Safety Congress held in New York City. In no other country in the world was such a conference as yet held and it remained for the engineers of the Daniel Guggenheim Fund to promote and establish an annual conference which today has an important effect on aeronautics throughout the entire country as well as several foreign countries who have since taken up the thought and carried it along.

The result of Colonel Lindbergh's tour of these United States for the Fund was the founding of a "Roof Marking Campaign," chrome yellow being selected as the most easily seen and distinguishable. In this instance the Fund worked closely with the Post Office Department at Washington, D. C., all postmasters in towns with 1,000 to 50,000 population being requested to take the initiative and organize local campaigns, the effect of which is seen at the approach of practically 70 per cent of all modern airports in up-to-date modern cities throughout the country. The American Legion, the Rotary Clubs, the Kiwanis, the Lions, the Exchange and other national civic organizations aided splendidly in the functioning and forwarding of such roof markings.

Then the Fund proceeded to gather data and experimental mythology on the dangers and prevention of accidents occurring through the medium of fog, the pilot's hazard, the manufacturer's foe and the laymen's terrific fear. Organized in August but commencing actual plans in September, 1927, the Full Flight Laboratory for the study of fog, under the direction of Lieut. James H. Doolittle, swung into prompt action. Stationed at Mitchell Field, Long Island, New York, through the courtesy of the Army Air Corps, Lieut. Doolittle started his preliminary experimen using a Consolidated "NY-2" and a Chance Vought "Corsair" in this work.

It is now only a matter of record of the success of this experimentation which ended last November when Lieut. Doolittle flew "blind" landing his airplane perfectly and using the instruments developed at the Full Flight Laboratory. These mentioned instruments included the use of a light radio transmitter which does not require a double voltage generator on the motor to supply plate voltage, with a capacity of 150 miles; the embodying of several instruments into one instrument which gives less direct indications, now manufactured by the Sperry Company; the employment of an "automatic" pilot, which controls speed and altitude and even holds the ship at altitude allowing the pilot to concentrate his attention on other instruments and on lines or landmarks outside the airplane on the landing field, thus permitting him to land "blind." Altimeters played a large part in this fog-flying success-landing, radio, acoustic, bomb, infrared and a gyroscopic turn indicator being used to full advantage.

It remains for a later generation to discover how to penetrate fog by visibility, no available means having been discovered in this intensive research work, some success, however, having been scored in fog removal, of which heating, penetration with charged particles, spraying and mechanical means have been tried with varied success. Prevention of fog is another problem left to the uprising aeronautical engineer and scientist.

In meteorology, the Fund selected the California Airway for experiments, which was conducted by Edward H. Bowie of the U. S. Weather Bureau stationed in San Francisco, Cal. The Western Air Express, the War and Navy Departments, the Pacific Telephone Company and the Secretary of Agriculture in Washington afforded the Fund excellent co-operation which resulted in a nation-wide network of meteorological stations which today are enabled to distribute information, through type-written sheets and bulletin boards, at every leading airport to the pilot on business or pleasure bent. In this research the Fund out-did itself, going to the extent of gradually having a definite agreement drawn up among the State Foresters, the District Foresters of the United States Forest Service and the United States Weather Bureau to act in unison to prevent forest fires. In one case, early in 1928, such co-operation enabled foresters at Santa Barbara, Cal. to herd the fire into one controlled basin where it was easily extinguished.

These facts and established theories do not conclude the Fund's activities, not with such a leader as Harry F. Guggenheim at the helm. Although the Daniel Guggenheim Fund for the Promotion of Aeronautics, Inc., officially "closed shop" on Dec. 31, 1929, $500.-000 additional capital has been received from Mr. Daniel Guggenheim for the complete realization of its objective. This gift does not include the $150,000 offered in grand prizes for the winners in the Guggenheim Safe-Aircraft Competition, said amount already having been provided. The new allocation will be divided as follows:

An appropriation of $250,000 being made jointly for establishing an Airship Institute, controlled mutually by the City of Akron, Ohio, and the California Institute of Technology, under the direction of an expert aerodynamical engineer, to conduct research in lighter-than-air development; $140,000 has been allotted for a Chair at the Library of Congress for the purpose of composing a complete aeronautical library in Washington, D. C., the present sources of such historical volumes being the Smithsonian Institute, the War Department at Langley Field, Virginia and the Navy Department, all of whom have consented to the transferring of their books to the new Chair at the Congressional Library; $25,000 was given to the Fund's committee on Elementary and Secondary Aeronautical Education conducted in the public schools, so that that committee will be enabled to continue for another year, including the preparation of textbooks, the conduct of courses on the teaching of aeronautics, and the assistance of introducing aeronautics in the school curriculum; $30,000 was granted to Syracuse University for aerial photographic surveying and mapping, and four grants made to European aeronautical organizations of $10,000 each, as well as sundry donations and grants.

The Daniel Guggenheim Fund for the Promotion of Aeronautics, Inc., deserves the praise of a clamoring public who offer particular thanks to Daniel Guggenheim for his philanthropic generosity, to his son, Harry F. Guggenheim who has served so faithfully and unswervingly in his duty to the Fund, and to Captain Emory S. Land, in whose hands the completion of the Guggenheim Fund's objectives have been placed, and to that Board of Directors, every one of whom has done his utmost for the uplifting of aviation and the promotion of aeronautics.

EUROPEAN AVIATION MEDICINE

by

Commander Robert G. Davis

Medical Corps, U. S. N.

THE rapid strides in aviation development throughout the world have opened a new field of medical research and today aviation medicine has taken its place among the more important specialties.

When the early casualties were studied it soon became evident that physical imperfections were largely responsible and a marked improvement resulted after the physical factors were stressed. The ounce of prevention adage aptly applies to aviation safety. The entire chain is dependent upon the link at the controls.

The selection and maintenance of pilots in the United States military activities engages the full time attention of specially trained medical officers known as flight surgeons. In the selection examinations physical fitness is stressed as are factors such as eye muscle balance, depth perception, high degree of visual acuity, reaction time, etc., in addition to a strict assessment of the circulatory, nervous and respiratory systems. Slight imperfections that may be of little or no consequence for ground duties or excellent risks for life insurance, may early become aggravated in the air, terminating the flight in disaster.

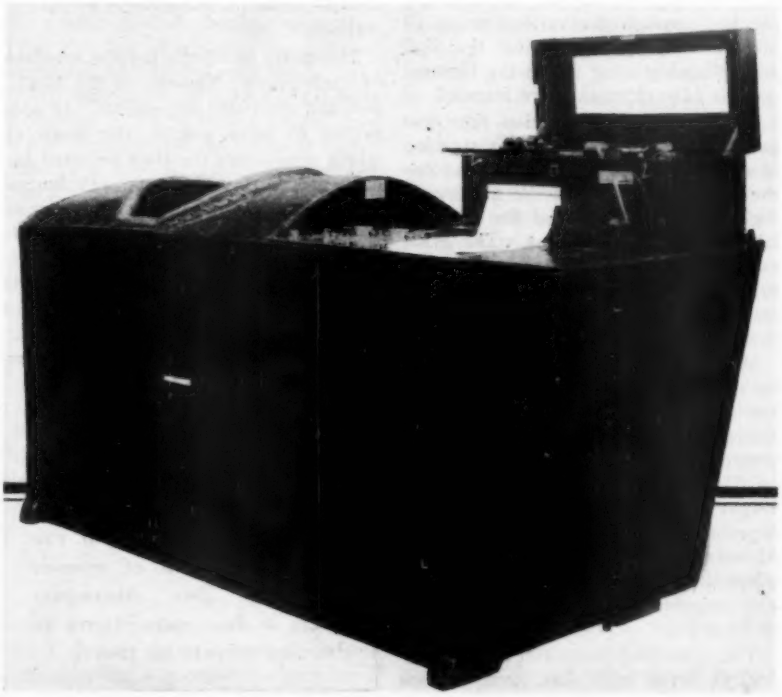
In order to obtain first hand information and make comparisons of United States standards with other countries, the writer recently visited the principal aviation centers in France, Italy, Germany and England. In each country was found a well-established aviation medical department carrying on research and conducting an examination of high physical requirements. The examining boards are composed specialists in neurology, physiology, internal medicine, and eye, ear, nose and throat, who remain more or less permanent on assignments and maintain a close contact with the studies conducted in the research laboratories.

The scope of the examinations in the United States and Europe is essentially the same with minor variations in the methods of recording the factors of physical efficiency. As the European examinations so nearly coincide in their standards they will be spoken of collectively.

Candidates are first carefully interviewed by a neurologist, covering past, present and family histories. The individual's bearing and general make up are noted as the answers are recorded and any suspicious trends are carefully analyzed. If the examiner is satisfied, after a sketchy picture of the candidate's life has been revealed, that he is dealing with a normal individual, no further personality study is made. The recorded history statements are signed by the applicant and the physical examination begins.

The eyes must be free of internal and external pathology, coordinated in movements, visual fields unrestricted and visual acuity 6/6 or 20/20. Ocular muscle balance is tested by the phorometer or red-green trial frames. Hearing is tested by whispered voice and tuning forks. Drums must be free from any pathology, eustachean tubes potent and upper respiratory passages free from disease or obstruction. The general physical examination is carefully

The Reid Aptitude Apparatus for flight training.



carried out by the internist. The circulatory respiratory and nervous systems are thoroughly searched for any present or latent pathology. Blood pressure and rate is recorded at rest, before and after exercise and time carefully noted of its return to normal. Vital capacity, breath holding and respiratory force is recorded. Simple self-balancing tests are observed, reflexes tested and tremors noted. Doubtful chest pathology is checked by X-ray plates.

The Baranay chair is used for routine equilibrium tests in France and Italy but only for doubtful cases in other countries in determining circulatory response to changes in equilibrium. Even though no imperfections are found in the physical examination, any history of neurasthenia, psychopathic trends, alcoholism, syphilis, recent malaria and chronic skin affections are all causes for rejection.

While the provisions of the Versailles Treaty restricted Germany to civilian flying, the same physical standards of military flying apply. The great responsibility of passenger transport piloting is adequately met and performance records are remarkable. Service as a pilot depends upon his health, especially the condition of his nervous system, organs of sense, lungs and circulation. Previous history of the applicant is carefully analyzed, especially his duties during the war, his attitude when in danger, and his interest in sports, all of which give an index of his general dexterity or versatility, disposition and physical endurance. Four years are spent in the Commercial Airplane Pilot's School and step by step the student is carefully checked through the various stages of advanced flying, developing the skill and reliability upon which the German records of performance are founded.

The questions of reaction time and general aptitude for aviation training to eliminate those who can not develop the ability to safely handle a plane in flight, have long engaged the research laboratories of all nations. The great expense and loss of time in endeavoring to train unadaptable applicants is a serious factor and their early elimination is essential.

While auditory and visual reactions have become measured by lights and buzzers, the British have gone a step farther and developed an apparatus invented by Squadron Leader Reid known as "The Reid Aptitude Apparatus for Flight Training." As it has passed the experimental stage, claiming 90 per cent of correct assessments, and has been adopted by the Air Ministry in all routine examinations, a short description is recorded.

The apparatus consists of a stationary cockpit fitted with seat, control stick and rudder bar. The latter are electrically connected with a mechanism of colored lights on the instrument board arranged in a semi-circle for the stick, with a horizontal line of light beneath for the rudder bar. These correspond with ailerons, elevator and rudder control. With all controls centered, white lights only appear, but any movement from the centralized position is immediately apparent by the illumination of red and green lights—red for port and green for starboard.

The candidate is instructed first to place the stick over to the extreme left position and when the current is turned on, lighting the semi-arc of four red lights, to quickly centralize the stick, blanking out the lights until the center white light appears. The movement must be gradual and delicate, as the slightest over-correction begins lighting the green arc of four lights. During the performance a self-registering chronograph is recording the time in one-tenth parts of a second, and only automatically ceases when the control white light is permanently lighted. Ten trials are allowed for practice and instruction, when ten tracings are recorded. Similarly, ten tracings are made with the stick from the extreme right of center, followed by the rudder from both right and left to the center.

Combined hand and foot movements are next recorded: Namely, right foot forward and stick to the left, as in a spin. During this test, a Klaxon horn is sounded to register the temporary disturbances followed by erratic or continued normal performance, depending on the state of the subject's nervous stability.

The peaks of all the parallel tracings of each group: Namely, of the hands, feet and combined movements, are connected to form graphs, the mean of which constitutes the time required for each group of movements. Prolonged tests with the apparatus at service flight stations have now established definitely that any candidate whose average reaction time is 4.3 to 4.5 seconds (especially if the curve is erratic) will prove unsuitable for training purposes. Excellent candidates record an average reaction time of 2.2 seconds, and an average candidate 3.3 seconds.

Repeated secret assessments of classes between the apparatus predictions and final reports of instructors have agreed in 90 per cent of the cases. Repeating the tests at intervals, a degree of improvability can be shown in promising candidates, but experience has revealed that improvability is not shown in erratic and slow reactions. It is claimed that the average promising candidate in training will be able to solo in 50 per cent less time than those who do not practice on the apparatus. It is strongly emphasized by both the medical and executive branches that the apparatus will not teach a pupil to fly, as no sense of flying is obtained, but it will assess the similar coordinated movements required in flying and in developing the degree of automaticity that distinguishes the skilled from the unskilled pilot.

The executive branch after repeated individual tests with the Reid Aptitude Apparatus, report it to be of definite value (a) by assisting in the early elimination of unsound pilots and thereby effecting economy by further reducing wastage, both in training and service units; (b) by assisting in original and thereby effecting considerable economy by reduced wastage in initial training; (c) by assisting in the actual flying training of pupils.

Group Captain Flack, director of the Medical Research Laboratory, agrees with the statements of the executive branch: "At the same time it is important to emphasize that the apparatus merely records the aptitude of the individual to perform certain functions and enables him to practice and subsequently develop the nerves and muscles which carry out those functions—functions similar to those performed in flying. The apparatus was not designed to teach and can not teach a pupil to fly, and consequently should not be called or known as a flying training apparatus, but as a flying aptitude apparatus."

Medical personnel attached to European aviation activities are not required to fly and the degree of their "flying line" activities are largely dependent upon their own initiative. Flight surgeons in the United States services are constantly in touch with pilots, both on and off duty, watching for the first signs of insidious deterioration that affect air performances.

Selection is highly important but maintenance of the flying personnel is the greater field. The physical standards, both at home and abroad, are not fanciful but founded upon the factors possessed by successful war time pilots.

COMING ARTICLES

Mr. Kyes, president of Glenn L. Martin Co., discusses aviation as a career. Marjorie Brown, well known pilot tells the inside story of the new organization of women pilots. J. Don Alexander offers a few suggestions to develop private air travel.

XUM

The Sky Fleet in flight formation.

AIR TOUR COSTS

A FLEET of seven three-place cabin monoplanes can be operated on a five months' tour from one end of the country to the other at a cost of approximately $1.05 a mile for the fleet.

This has been demonstrated by the "Sky Fleet" of the General Tire and Rubber Company which recently completed the first nation-wide air tour ever made by a commercial fleet of airplanes.

The cost per mile for each of the seven planes in the "Sky Fleet" was approximately 15 cents. This figure included cost of gasoline, oil, hangar space, repairs including mechanic's wages, depreciation and passenger liability insurance, but did not include salaries or expenses of the pilots, fleet manager or other company officials who accompanied the tour at various times.

The Department of Commerce recently announced that the average cost of operating an open cockpit airplane, costing about $3,000, engined with a 90 h.p. motor and carrying three persons at an average speed of 100 miles an hour, was 9.39 cents per mile. It has been estimated that it costs 6.43 cents a mile to operate the average motor car.

In comparison with these costs, the "Sky Fleet" ships were cabin ships, costing about $8,000 each, with higher powered motors and lower cruising speed, which accounts for the slightly higher operating cost per mile.

During the 18 weeks that the fleet was in the air, it flew over 32 states, several of them many times, and covered approximately 20,000 air miles.

In addition to the cross-country flying between various cities, many air miles were covered in passenger-hopping at the airports visited. Probably 2,000 persons were taken for rides which ranged in duration from 10 minutes to an hour.

The seven ships in the "Sky Fleet" were identical, being three-place cabin monoplanes, powered with Warner Scarab 110 h.p. seven cylinder radial air-cooled motors, with a cruising speed of 85 to 90 miles an hour at 1,850 r.p.m. At times, the ships were revved up to 2,100 r.p.m. and attained a speed of 115 miles an hour.

Due to various causes all of the seven ships did not accompany the fleet at all times so that costs have been calculated by taking the actual figures for one of the ships that flew the entire distance on the tour and multiplying it by seven.

Each ship consumed approximately 1,380 gallons of gasoline, at an approximate cost of $355. This would make the average cost of gasoline 25.6 cents per gallon although at some of the airports visited, the gasoline was free. Thus the cost of gasoline for the fleet would be approximately $2,480.

Approximately 178 quarts of oil were consumed by each of the seven ships at a total cost of $58 per plane or a total expense of $406 for oil for the fleet for the tour. This would make the average cost of oil 32½ cents a quart.

During the 18 weeks, the average ship in the fleet piled up 235½ flying hours. The longest flying time in any one week was 23 hours and 15 minutes and during the week when the least flying was done, the number of hours in the air was five minutes more than eight hours.

If the average cruising speed of each plane is estimated at 85 miles an hour, the total of 235½ flying hours would indicate that the fleet had traveled approximately 20,017 miles on the tour.

Cost for hangar space is estimated at $85 for each ship. In many cities, hangar space for all of the planes was not available so none of the planes was put into a hangar. As airport facilities increase and as hangar space becomes more plentiful, the cost of hangar space for such a tour would naturally be somewhat increased. This would make the total cost for hangar accommodations for the fleet $592 for the tour.

Cost of all repairs made to the seven planes while en route, as the result of minor crack-ups, and the wages of one mechanic who accompanied the fleet at all times, amounted to $4,262.22, which would mean an average of $609.03 for each of the seven ships.

As the life of an airplane is estimated at five years, the annual depreciation would be 20 per cent of the total cost. On a tour like this, however, when the planes were subject to unusually severe service, it is fair to estimate the depreciation during five months as equal to an average depreciation of one year.

This would make the depreciation for the fleet amount to $9,000 or $1,285.75 for each of the seven ships.

Only passenger liability and public liability insurance was carried on the planes in the "Sky Fleet." No insurance against damage to the planes was carried as one and one-half airplanes could have been lost completely for the price of the premium. It was found cheaper not to carry crack-up, fire and theft or windstorm insurance.

Insurance charges for the fleet amounted to $5,404, making an average insurance premium of $772 for each ship.

The "Sky Fleet" tour was conducted to test out and demonstrate the practicability of various new safety devices, made of rubber, for use on airplanes, and to encourage the development of commercial aviation in every way possible.

As a test-car tests out new developments in automobile tires under every imaginable condition of weather or highway, so the planes in the "Sky Fleet" conducted their tests under every imaginable kind of flying conditions and in all sorts of weather.

XUM

Aeronautic Law

by
Bailey Samelow
Member of the Chicago Bar

JUDGE JOHN DOE, of Chicago, an enthusiast in flying, has to run over to New York City. He requests his bailiff to procure for him a reservation in a passenger plane. His cautious bailiff, alert to the intricacies of the law, inquires as to whether or not it is necessary to obtain permission from the various states between Illinois and New York to fly over them.

In 1926 Congress, under its constitutional power to regulate commerce among the several states, passed an act known as the Federal Air Commerce Act, regulating interstate commerce by aeroplane. This act permits aviators engaged in interstate commerce to fly from one state to another or over any state or territory in the United States, without subjecting themselves to the particular laws of the states over which they fly.

"A" INVITES "B" for an aeroplane ride from Boston to Los Angeles. Somewhere between these two points, while in flight, "A" perforates "B's" head with a few .32's. Upon arriving at Los Angeles, "A", a bit careless about his exploits, falls into the mazes of a meddling detective squad, with resulting charges of murder. The question that then confronts the state is, where can "A" be tried for his alleged crime.

Congress derives its powers from the Constitution of the United States. All powers and rights not specifically surrendered by the respective states to the Federal Government are recognized as being reserved by and belonging to said states. At the time the Constitution of the United States was adopted, aircraft was unknown. No provision covering aerial navigation was made in the Federal Constitution. The Uniform State Law of Aeronautics, a uniform code of laws pertaining to aviation, adopted so far by about 11 states and one territory, also sets forth that the adopting state reserves unto itself sovereignty in its air space, excepting where jurisdiction thereto has been granted to and assumed by the United States.

No state thus far has surrendered to the United States its jurisdiction over crimes and criminals. Jurisdiction over the criminal act involving "A" in the foregoing case would, therefore, be governed by the laws of the state over which the aeroplane was flying at the time the murder occurred.

The laws of every state of our country provide that crimes committed in a state shall be tried in the county where committed, unless a change of venue is granted to another county in the state because of the prejudice of its inhabitants or the judges of said county.

The arm of the law, endeavoring to bring the enmeshed "A" to justice, bears the burden of proving the place where the murder was committed. The accused, having the right not to testify against himself, cannot of course be compelled to tell, if he knows, in what state or county, the fatal bullets were lodged in the head of the man declared to have been murdered. And were "A" to remain silent upon his trial, it would be impossible to prove the venue of the crime—that is, the county over which the crime was committed. That being so, and venue being as important an element of proof as the murder itself, it would be impossible to try "A," and the court would be compelled to let him go.

Had the crime been committed in the air over the ocean, within our three-mile limit, it is doubtful whether there is any law which could be applied to the crime. Under the constitution of the United States, Congress has the power to punish felonies committed on the high seas, but to date such power has been limited to crimes committed within the maritime and admiralty jurisdiction of the United States, or aboard vessels belonging to the United States or citizens of it.

Whether an aeroplane flying over the ocean outside of the three-mile limit would be subject to maritime or admiralty law of the country is doubtful, for though it is a mode of locomotion, yet it is not a vessel upon the high seas in the legal sense in which such language has been heretofore used, and the criminal statutes providing for punishment of crime are very strictly construed.

Had the murder been committed beyond the three-mile limit, the problem would have been still more perplexing to authorities. It is doubtful whether the act would have been at all cognizable by the laws of the United States or any of its states.

WALTER RALEIGH in his article appearing in this issue, entitled "Seadromes," asks certain hypothetical questions. These can be answered briefly, as follows:

(1) Beyond the marine zone (three-mile limit) of nations, the open sea is the common highway of all nations, and no nation can claim for itself a superior or exclusive prerogative there. This status is recognized by the law of the nations of the world known as International Law.

(2) Before seadromes such as contemplated can be built, the nations of the world would undoubtedly have to be consulted and an international agreement entered into regarding such seadromes. Such an agreement would, of course, cover the questions of construction, sovereignty, jurisdiction, usage and maintenance.

(3) Being 400 miles or more at sea, this country would not be able to enforce its prohibition laws.

(4) Disputes pertaining to aviation, arising from the situations set forth, will perhaps be referred to the Court of International Justice sponsored by the member nations of the world.

THIS department of Aeronautic Law is open, not only to the laity, but also to lawyers, legislators and city law makers as well. Address your questions of aeronautic law to Legal Department, AERONAUTICS, 608 South Dearborn Street, Chicago, Illinois. Replies will be by mail unless a special wire is requested. Some of the questions will be answered in these pages.

XUM

Alexander Klemin
Professor of Aerodynamics, College of Engineering, New York University

Article 16
Airfoil Characteristics

AERODYNAMICS

IN spite of the hundreds, perhaps thousands of airfoils tested in the various aerodynamic laboratories of the United States and Europe, no "best" airfoil has been discovered. Some airfoils are better from one point of view, some from another. For a given airplane design, however, there are generally some two or three airfoils to be found which fit the particular problem best.

We will first of all classify the various airfoil characteristics which are desirable.

1. *A low value of the Minimum Drag.* This is very important for high speed machines, which fly at small angles of incidence, at or near the condition of minimum drag. We have seen in a previous article that horse-power required $= \frac{Kx\ AV^3}{375}$. If Kx is small it is therefore possible to get a higher speed with a given power, or to call for less power with a given speed.

2. *A high value of Maximum Lift coefficient.* The stalling or minimum speed is given by the formula $V = \sqrt{\frac{W}{Ky\ max.\ A}}$. Hence a high value of the maximum Ky will give a lower landing speed, or with a given landing speed allow the use of more loading per square foot, giving a smaller, more compact and lighter airplane.

3. *A high ratio of Maximum Ky to Minimum Drag.* One of the principal requirements of airplane design is a good value of speed range, that is maximum speed divided by minimum speed. Since high maximum Ky tends to low landing speed, and low minimum Kx means good high speed, it is clear that a high ratio $\frac{Ky\ maximum}{Kx\ minimum}$ is an indication of good speed range.

4. *A high value of Maximum Lift/Drag.* Machines are not generally loaded enough per square foot to fly at the angle of best Lift/Drag at cruising speed. Nevertheless a high value of maximum L/D is a good indication of cruising efficiency. For a commercial airplane which is to fly cross-country at cruising speed, high maximum L/D is probably more important than a very low value of minimum drag.

5. *A high value of Lift/Drag at climbing angles.* An airplane generally climbs best at a fairly high angle of incidence, between 8 and 10 degrees incidence. As a rule in commercial airplanes, the climb is quite satisfactory. Nevertheless a thorough analysis of an airfoil should include a consideration of the L/D at climbing angles. Perhaps a better way of picking a climbing wing is to consider what is known as the power coefficient rather than to pick L/Ds at random in the region of climb. The power coefficient is obtained as follows:

$$\text{Wing Thrust} = \frac{\text{Weight}}{\text{Lift/Drag of wing.}} = \frac{W}{L/D} = \frac{W}{\frac{Ky}{Kx}}$$

$$\text{Wing horse-power required} = \frac{\text{Thrust x V (miles per hour)}}{375}$$

$$\text{But } V = \sqrt{\frac{W}{Ky\ A}}$$

$$\text{Therefore horse-power required} = \frac{W}{Ky/Kx} \cdot \sqrt{\frac{W}{Ky\ A}}$$

$$= \frac{W\sqrt{W}}{\sqrt{A}} \cdot \frac{1}{\frac{Ky\sqrt{Ky}}{Kx}}$$

as can be readily determined by using a little algebra.

With fixed weight and area, the horse-power with the plane flying at any Ky will therefore depend on the value of $\frac{1}{\frac{Ky\sqrt{Ky}}{Kx}}$ or $\frac{1}{\frac{Ky\ 3/2}{Kx}}$

When the wing horse-power is the smallest possible, $\frac{Ky\ 3/2}{Kx}$ must have its maximum value.

But an airplane climbs best when the wing horse-power is approximately at its lowest value, because there is then a maximum of excess power to overcome gravity.

Therefore the airplane will climb best when its $\frac{Ky\ 3/2}{Kx}$ is at its maximum value.

For climb, that airfoil will be best which has the highest maximum value of $\frac{Ky\ 3/2}{Kx}$.

6. *Small Center of Pressure Travel.* We have seen in previous articles, that the ordinary conventional wing has an unstable center of pressure travel. When the wing noses down, the center of pressure travels back and increases the nosing down tendency. When the wing noses up, the center of pressure travels forwards and increases the nosing up tendency. Hence from a stability point of view, it is desirable to have as small a center of pressure travel as possible. By a slight turning up of the rear part of the airfoil it is even possible to obtain a constant center of pressure. There is also another advantage in a small center of pressure travel, and that from the structural point of view. When the center of pressure travels forward, it is the front spar that is bearing the major part of the wing load. When the center of pressure travels back, the rear spar has to withstand the greater strain. With a small c.p. movement the loads can be concentrated more on one spar, and the

wing made lighter accordingly.

7. *Depth of Spar.* If we take a flat ruler, and hold it flat, it is quite easily broken. The same ruler held on edge, will not be readily broken by the strongest fingers. A beam to be strong should be narrow and deep. From a structural point of view, therefore, that airfoil will be best, which allows of the design of deep spar, both front and rear.

What is a Desirable Wing profile

So many airfoils have been developed, tested and studied that it is impossible for us to consider even a small proportion of them in detail.

Speaking generally, an airfoil should have:

1. A generally pleasing, streamline appearance, with no very abrupt changes of curvature anywhere, no gaps or breaks on upper or lower surface.

2. A nicely rounded front nose, and a sharp trailing edge, or a trailing edge coming to a rounded point of very small curvature.

3. A maximum thickness at about one-third of the chord from the leading edge.

4. Neither excessive upper camber, since this may mean excessive drag with no compensating increase in lift.

5. No excessive hollowing out of the under surface, since this may mean excessive drag not compensated for by the increase in lift, and also reduction of the spar depth available.

6. No excessive camber below the chord line, since this will decrease the lift, even though minimum drag may be diminished thereby.

These geometric considerations are illustrated in Fig. 1.

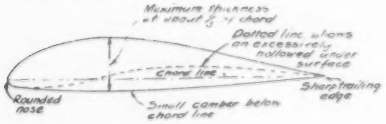

Maximum thickness at about ⅓ of chord
Dotted line shows an excessively hollowed upper surface
Chord line
Rounded nose
Small camber below chord line
Sharp trailing edge

Fig. 1. Desirable characteristics of Wing profiles.

What Theory Teaches Us About Wing Profile

In recent years, hydrodynamics, the theory of fluid flow has been very successfully applied to the study of the airfoil. It is impossible without an extensive knowledge of mathematics to appreciate this theory. It is, however, possible to take the findings of modern theory, to see if it corresponds with common sense, and to use its results for the appreciation of wing profiles.

The first thing that hydrodynamic theory teaches us is that the characteristics of an airfoil depend above all else on the mean camber line. The mean camber line is illustrated in Fig. 2. It is obtained by taking the mean of the ordinates of the upper and lower surface of the airfoil. The camber of an airfoil is defined by the ration of maximum camber to chord.

Fig. 2. Showing mean camber line.

Another way, though only approximate of defining the mean camber is to join the mid-point on the mean camber line to the trailing edge. The angle between this line and the chord may be termed the mean camber angle; the chord is defined as the line between the extreme leading edge and the trailing edge. It is illustrated in Fig. 3. This angle is generally denoted by the symbol β (beta).

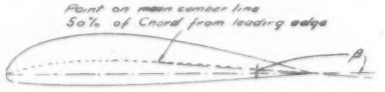


Fig. 3. Showing angle β.

We have seen previously that when the chord is at zero the lift is not necessarily zero. The lift is zero, however, when the wind strikes the airfoil along this line from the trailing edge to the mid-point on the mean camber line. This line may therefore be termed the line of no lift, and it makes an angle β (beta) with the chord line.

As the mean camber increases, so does the value of the angle β. This is illustrated in Fig. 4. For the symmetrical, double cambered profile shown in this diagram, the angle β is evidently zero. And when the chord line of the double cambered surface is at zero, the lift is zero also. For the thin airfoil, of small mean camber β has a value of something like 4 degrees, and the lift is zero when the chord is at –4 degrees accordingly. For the thick, heavily cambered airfoil, the angle β is 6 degrees and the chord must be at –6 degrees before the lift disappears.

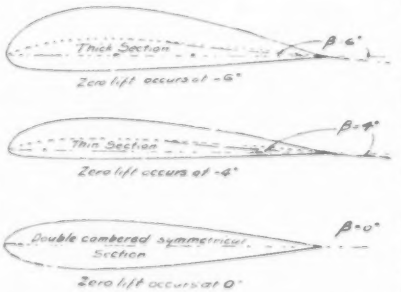


Fig. 4. Showing increase in angle β with mean camber.

There is another very interesting fact to be learned from this Fig. 4, and that is that the lift curve of the airfoil when plotted against angle of incidence always has approximately the same slope.

If we know the value of this slope, we can calculate the lift coefficient for any angle of incidence. From wind tunnel tests for wings of aspect ratio 6, it has been found that this slope is approximately .000184 Ky per degree.

Suppose that we want to calculate the lift of an airfoil of camber angle β of 6 degrees, when the angle of the chord is 4 degrees. The wing is then at 6+4 degrees from the angle of no lift. The Ky is therefore 10 multipled by .000184 or .00184.

The reader may ask how the mean camber angle is related to the maximum lift coefficient.

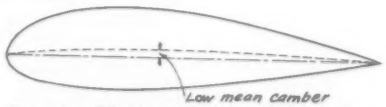


Fig. 5. Thick airfoil with low mean camber.

All airfoils reach their maximum lift at approximately the same angle of incidence of the chord. But the thick heavily cambered wing started lifting at a bigger negative angle. The range of the angles from zero lift to maximum lift is therefore larger, and with the same slope, the maximum lift is larger.

This camber angle β also serves to indicate the center of pressure motion.

The position of the center of pressure is given approximately by the formula $\text{C.P.} = \frac{\beta}{141\ \text{Ky}} + \frac{1}{4}$. So the greater the value of β the greater is the travel of the center of pressure.

The greater the mean camber and the greater the thickness of the wing, the greater also the minimum drag.

We have to pay for increased lift, obtainable by greater mean camber, therefore by a greater movement of the center of pressure and by greater drag. Nevertheless the designer may select the wing of greater mean camber for other reasons, such as low landing speed and greater spar depth.

There is one more point to make clear. The wing may have great thickness, yet low mean camber. This is illustrated in Fig. 5 where the wing has a convex camber on the lower surface, and a low mean camber, though it is very thick.

Where a designer needs great spar depth, as at the root of an internally braced cantilever wing, it is possible to keep the mean camber within reasonable limits, yet to secure the spar depth by using a convex camber on the lower surface. This is a very useful aerodynamic dodge.

There is still another very useful

[*Continued on page 76*]

AERIAL NAVIGATION

Maps and Mapping
Part I

by
Cdr. Douglas G. Jeffrey, R. N.

"Perhaps the main consideration in air pilotage is to maintain direction; without a map a desired direction can not be ascertained" (Manual of Air Pilotage.)

THE literal meaning of topography is "the description of a place" and a map is merely a drawing illustrating this description. Step by step, the amount of information that maps contain has been increased, until the modern topographical map is a veritable encyclopedia of the district portrayed.

The amount of information that can be compressed into any map depends largely on the perfection of the system of conventional signs employed, and also, of course, upon the size of the map with relation to area that it represents.

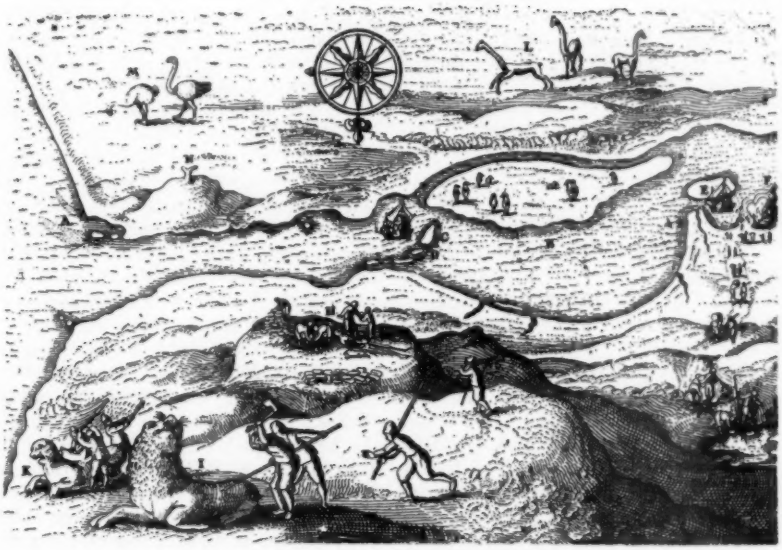
It is obvious that the larger the scale, the more detailed is the information, and it is equally obvious that the larger the scale, the more cumbersome the map becomes.

To quote Mr. Bradley Jones (a well known navigation authority): "All the area of maps fall under four headings —finding the distances between places, finding the direction of one place from another, finding the shape of a landmark, and comparing the size of landmarks."

Unfortunately no maps are accurate, owing to the impossibility of representing a round surface or a flat one, and it is equally impossible to produce a map that will fulfill all the four uses indicated above.

Thus we have the Cadastral maps in large scales, showing the boundaries of properties and individual buildings, necessary for local administration, the management of estates and taxation, etc. At the other end of the list are the Atlas maps, in very small scales and giving only the principal ranges of hills, main stems of rivers, big towns and perhaps main lines of railways. They aim at representing on a single sheet, a whole country or continent.

It is, however, the topographical map that is the basis of our aerial maps of today, and for the time being, at least, we may forget the other 57 varieties. At the time when old man "Mars" is being so roughly handled and when peace pacts are the order of the day, it may be interesting to note that War, more than any other single agency, has been responsible for the perfection of the modern topographical map. The Ordinance Survey of Great Britain owes its origin to the Highland Rising in 1745. The mapping of the Highlands and the military roads that the survey made possible, put an end forever to the Highland Forays.



Sketch map from Schoutens "Journael" of 1588.

It was an error in a map that was the direct cause of the reverse at Calenso Natal during the Boer War, and that eventually led to a very thorough survey of the whole of the Union of South Africa being undertaken.

Let us get back to our aerial maps. As early as 1911, special aerial maps were prepared in both France and Great Britain. In France, by Service Geographique de l'Armee, and in Britain by the War Office. At the meeting of the British Association, held in Portsmouth, England, in 1911, there was an interesting discussion on aero maps and a strong divergence of opinion was manifested. The military flying men were not pleased with the special map, and declared a favor of the ordinary half-inch topographical maps which, though not perfect, were better than the aero maps. The civilian fliers complained that they needed something more simple and easy to read than the survey maps. In this connection it is interesting to note that the only competitor who did not get lost in the circuit of Britain flight, in that year, was a French Naval Officer who flew over ground, with which he was quite unacquainted, by the aid of a quarter inch map, and all the competitors who relied on route maps, specially prepared, came to grief.

The special maps that had been prepared by the General Staffs were an honest attempt to depict the country as

it appears from above. The roads in this instance, were shown in white, but just before the Circuit Race the main roads in Britain, that had been extensively tarred, were actually less conspicuous than the secondary roads. That the ordinary topographical map contains a lot of detail that is unnecessary to the airman is granted, and also that a modified form of map is necessary for aerial purposes, but "the country as it appears from above" idea may be overdone. The Marine Chart doesn't depict the Coast as it is *seen* from the sea, but is a modified form of map, with particular conventional signs suitable to marine use. It is just as essential, in fact, in view of the paucity of trained aerial navigators that the airman should be able to read a map, as that the mariner should be able to read a chart.

If the airman is lucky enough to receive his training in the fighting services, he will learn the art of map reading. There are a few, if any, commercial schools which devote requisite time to this phase of aerial navigation.

The candidate for a transport pilot's license should have at least the same standard in this subject as is required from any commissioned officer in the Army or Navy.

The maps that were used in the seaplane raid on Cuxhaven, Christmas, 1914, were specially constructed under the supervision of Lieut. Erskine Childers, R.N.V.R., (author of "The Riddle of the Sands") who had an intimate and first-hand knowledge of the German coast. These were not maps in the strict sense of the term, but were course charts that depicted various prominent objects that the flier should pass on his flight and they were actually drawn on the chart in much the same way that our forbearers drew their bears and trees, etc., on their maps. (See accompanying sketch from Schouten's Journal, 1588.)

Courses were laid down so that all alterations, of course, took place near some of the prominent objects and the object was shown pictorially, out of all proportions to its relative size.

While this method proved successful on a particular occasion, it can hardly be recommended for general use although it might be well to accentuate the characteristic shapes of road junctions and crossings, etc.

On ordinary survey maps, these shapes are generally masked by exaggerated conventional width of roads. There has been much talk of a final international standard both for scales and conventional signs, but so far little has been accomplished, and the U.S. government, which is doing such yeoman service in aerial mapping, was not represented at the last international convention on Air Navigation. This august body did decide on a scale and standard convention signs for what are known as *International General Aeronautical Maps*. These are on "Mercator Projection" on a scale of three centimeters to one degree of longitude. The comment on these maps in the manual of Air Pilotage is significant: "The scale is too small for these maps to be used in the air but they are useful for reference."

Having mentioned Mercator's Projection, let us consider just exactly what it and other projections are. A gentleman called Gerhard Kramer published a map of the world on Mercator's Projection, 1569. Practically all aerial maps in use at present, are on Mercator Projection, which represents the earth as though it were a cylinder, rather than a spheroid.

To take an every day example—Were an attempt made to flatten the peel taken from half an orange, any marking on the outside of the peel would be distorted as the flattening process went on. If, however, the peel were saw-toothed from the top (i. e. the pole) to the flat out, (i. e. the equator) it could be pressed flat without wrinkling. Imagine a section of the spheroid treated in the manner as shown above, we would have the original delineations shown, but due to the saw-teeth the proportion would be lost. The further toward the top of the orange peel, or the Earth's pole, a feature was located, the more emphasized would be the distortion. A lake situated at the Equator, not being subjected to the Easterly and Westerly pull or stretch would retain its original shape, while at a Latitude of 50° the lake would be stretched to nearly double its normal easterly and westerly dimension, and by virtue of retaining its northerly and southerly dimension, would be out of proportion. (Fig. 1).

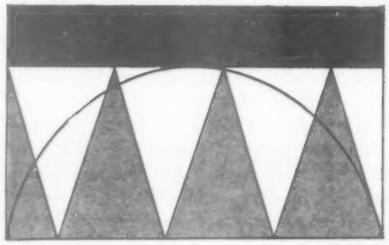


Fig. 1.
Legend
Circular portion—Original slope of spheroid.
Unshaded portion—Cut out sections to leave saw teeth.
Light shaded portion—Sections retained.
Dark shaded portion—Elongation necessary to preserve original proportion.

Should the meridians be stretched so as to keep pace with the parallels, the original proportions would remain. This is what occurs during the construction of a Mercator's Chart. Each minute of latitude is lengthened a trifle, so as to maintain the original proportion of the chart.

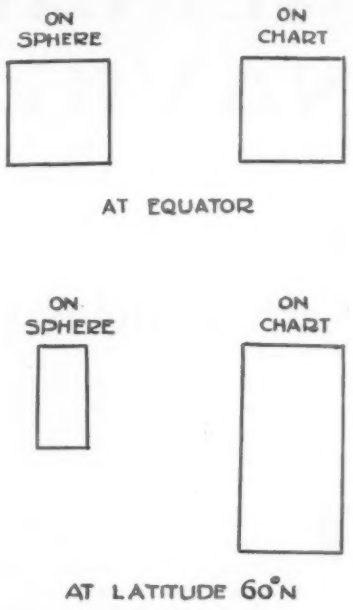


Fig. 1a.
Relative areas on the sphere and mercator's chart.

In high latitudes the Mercator chart is not reliable as the distortion becomes excessive, and bearings taken will not plot correctly. All the Meridians on a Mercator Chart are parallel and cut the Equator at right angles. They all are true North and South while the parallels of Latitude are true East and West and cut the Meridians at right angles. The length of a degree of longitude on the spheroid grows smaller due to the convergence of the Meridians, but as all the Meridians on a Mercator chart are parallel, the length of a minute of Longitude must everywhere be the same. In the same proportion that the degrees of Longitude have been artificially lengthened, beyond their true length, must the degrees of latitude be lengthened in each latitude. (Fig. 1a).

Each minute is lengthened by an amount known as its Meridional Part. Referring to the lake we stretched easterly, with the addition of the requisite Meridional Parts, we have restored its proportion but have nearly doubled its area. To compensate for this, it will be noted that the Latitude scale on the Chart carries a constantly increasing value to the North; on a Chart where 1° had a length of 1 inch at the Equator, it would have a length of about 1.8 inches at 56° North Latitude.

The gnomonic or Great Circle Projection assures the observer to be at the center of the earth and lines are drawn from the observer through the different points on the surface until they reach plane X (Fig. 2), which

[*Continued on page 82*]

Monthly Financial Review

by

J. Allen Grover
Pynchon & Co.

THE stock market for the past month has acted exactly as close market observers predicted that it would. It appears that it is very much easier after a panic to look back and discuss the warnings and suggest remedies for the future than it is to accomplish the same most desirable thing before the disaster. What happens, of course, each time is that the warnings are there just as prominently as they ever were before, but the mob enthusiasm, fastened on to people's judgment and imagination like a leech, blots out these valuable warnings. This was true in the panic of the past month, but only a few had the perspicacity and the courage to stand out against the mob and they were doomed to be called fools and traitors to the country's prosperity by the unheeding masses.

The strange thing is that since the break, everybody is in accord as to what the future course for the next six months or so will be. On November 13, the stock price averages, compiled by the New York Herald Tribune, stood at 155.6, the low for the year. By November 21 the sharp recovery which had been predicted had taken place and averages stood at 172. In other words, the panic was over and the period of dullness had set in. In the month since November 21, these same averages have been as high as 176.5 and as low as 170.7, and on December 18 they stood at 172, exactly where they had been on November 21.

Meanwhile, volume of sales, always an important indicator of the trend of the market and public participation, has declined until the trading on December 18 totaled only 2,277,000 shares, a low mark since last June. There does not seem to be any disposition on the part of those professionals, who might really influence the trend, to do more than sit on the side lines. Most of the selling has undoubtedly been for purposes of establishing income tax losses and most of the buying from investors with spare cash who occasionally feel that the standard issues have reached bottom levels. This backing and filling continued until well after the first of the year. When the Spring demand begins to assert itself, there may be some resumption of public enthusiasm for a rising market, but the leading business executives and economists of the country, who have ventured an opinion, seem to agree that it will be June or thereabouts before a complete return to normal can be hoped for.

For the man with surplus money at the present time, there are many tempting purchases, but we would be inclined to advise a position of extreme caution. In the writer's opinion, it is better to buy stocks a few points higher than at present levels but with sound assurances from fundamental indicators that they are on the upturn, than to pay what are now considered rock-bottom prices and then possibly see them sell lower or remain stationary for months longer.

The aviation stocks have staged less of a recovery than other industrial issues, which is perfectly natural, considering that most people have been looking out for dividend-paying securities yielding a fair return on the investment. Very few aviation stocks can come in this category as they are all frankly speculative. Aviation stocks declined before the big break came in the market as over-production made itself evident there before it did elsewhere. The decline on the whole was no more severe than on any other speculative stocks, but the recovery so far has been slower. When the turn once comes, however, aviation stocks being extremely sensitive will surely feel the constructive influence more pronouncedly than other issues. For the speculator with some knowledge of the intrinsic merit of the companies, or with good advice from his banker or broker, there looms a great opportunity to make money on the constructive side in aviation securities within the next year.

New Companies—There have been no new aviation companies of any importance formed during the past month.

Aviation Finance—The Glenn A. Martin Company's first public financing is being undertaken by a syndicate headed by Otis & Co., of New York, who are offering $3,000,000 five year 6% Convertible Notes at 97.

Earnings Reported—The Curtiss Aeroplane & Motor Company reports for the first nine months of 1929 that they earned $3.93 on the common stock, against $2.08 for the same period of 1928.

The Bendix Aviation Corporation for the nine months ended September 30, 1929, reports earnings of $3.26 per share.

Irving Air Chute Company for the ten months ended October 31 reports earnings of $2.04, which includes earnings from British properties for the first six months of the year only.

Official estimate has been made by the Western Air Express giving their approximate 1929 figure as $7 per share.

The Aviation Corporation of Delaware reports that for the nine months ended September 30th they showed earnings of 14c a share on the common stock.

United Aircraft & Transport Corporation has officially estimated their net income for the fourth quarter to be equal to $1.53 a share, which would bring their total 1929 earnings to $5.27 a share on the common stock.

THE INVESTOR

With aviation stocks changing position rapidly in an industry complicated by swift growths and rapid amalgamations, the opportunities for both wise and unwise investment are large. It is only on the basis of accurate and newest information that proper judgment of value may be achieved.

In order to service those readers who are interested in investment possibilities AERONAUTICS will secure the best available information on all current investment possibilities on request. Queries should be addressed to *Aeronautics Advisory Investment Service.*

THEY TELL US-

A Forum of Comment, Criticism and Remarks

Below are some of the replies evoked by the editorial, "Developing a Cream Market," which advocated aviation training in universities and colleges, appearing in the January issue of AERONAUTICS.

Albuquerque, N. Mex., Dec. 20, 1929.—I am informed by Dean R. S. Rockwood, of the College of Engineering, that it would not be a difficult matter for us to establish a flying school in cooperation with the Albuquerque Airport Company, who have several times urged such a connection with the University. It would be necessary for us to work out the details of arrangements, but I do not think there is any doubt but that it could be done.

In regard to the courses which would have to be given, Professor Baker is well fitted for the ground courses in aeronautics, and I believe we could, with very little expense, provide an excellent ground school for aviation at the University. Personally, I am heartily in favor of this program and should be glad to have any further suggestions from you as to how we may best proceed to the establishment of this flying school.

J. F. ZIMMERMAN, PRESIDENT
—THE UNIVERSITY OF NEW MEXICO

Dover, Del., Dec. 9.—If you are advocating flight training courses at college, which are not compulsory, I think the idea might meet with more favor than if all students are required to take the course.

C. DOUGLASS BUCK, GOVERNOR
—STATE OF DELAWARE

Santa Fe, N. M., Dec. 10.—I agree with you that all states should do what they can to promote commercial aviation.

R. C. DILLON, GOVERNOR
—STATE OF NEW MEXICO

Washington, D. C., Dec. 17, 1929.—I believe that it is quite possible and certainly desirable for some universities to do this very thing but I am afraid it is not possible on a wholesale scale: certain schools are so situated that they can do this both geographically and financially but the majority of them I am afraid would have to depend upon another method.

MELVIN J. MAAS, REPRESENTATIVE
—CONGRESS OF THE UNITED STATES

Columbus, Ohio, Dec. 18, 1929.—Governor Myers Y. Cooper has referred to me your letter of December 6th enclosing proof of the editorial relative to providing flight training in college, with a view to building up a market for owner-pilot planes.

I would have no hope of securing a state appropriation for the training of pilots at any state-supported university in Ohio.

JOHN M. VORYS, DIRECTOR
—BUREAU OF AERONAUTICS, STATE OF OHIO

Madison, Wis., Dec. 12.—It seems to me not entirely clear that flight training courses should be included in the curricula of state universities and I should not want to express as advocating and thus appear to put some pressure on our own university to establish such courses.

Possibly there might be arguments in favor of scientific courses having a relationship to aeronautics which would not apply with equal force to courses looking to the training of pilots.

I am not expressing opposition to what you propose, but there is some doubt about it in my mind.

WALTER J. KOHLER, GOVERNOR
—STATE OF WISCONSIN

Lincoln, Nebr., Dec. 12.—I of course am deeply interested in aviation. I venture the suggestion that there may be danger of plunging in too suddenly and too deeply. The ambitious program you outline may possibly be excessive in its enthusiasm. While transportation and travel by air will cut a big figure in the near future, to my mind it has its limitations by reason both of high cost and dangers yet to be overcome. I feel that a word of caution is well timed.

I commend your efforts in working for the development of aviation.

ARTHUR J. WEAVER, GOVERNOR
—STATE OF NEBRASKA

Salt Lake City, Utah, December 21, 1929.—The thought occurred to me as I read this that perhaps there is not enough demand at present for aviators to make such a course of training advisable.

GEORGE H. DERN, GOVERNOR,
—STATE OF UTAH

Lansing, Mich., Dec. 18, 1929.—While I am interested in the promotion of transportation by air as fast as the public is ready to avail itself of that means of transportation, I would hesitate to go on record in favor of having all colleges and universities establish a training course at their institutions.

My opinion would be that the matter of establishing training courses at colleges and universities is one that can be better determined by the faculty and the governing boards of the different colleges and universities.

The growth of air transportation and all matters pertaining to aeronautics should not be pushed beyond the point where the public is willing to accept it.

FRED W. GREEN, GOVERNOR
—STATE OF MICHIGAN

Little Rock, Ark., Dec. 12.—I am not familiar enough with this question to voice an opinion as to its exact value in the immediate future. My general opinion, however, would be that it is only a question of time until the study of aeronautics will be embraced in the various college curriculums. Only a few years ago past it was thought inconsistent to teach motor mechanics in the various institutions of learning, but today these courses are offered in most of the larger high schools. The value of aviation is quite apparent, and as it advances in the various sections of the country so will its importance be realized and its consequent adoption in the various schools and universities would subsquently follow.

From a military viewpoint, I am of the

AERONAUTICS presents here the informal opinions of vital men, believing that in a rapidly changing industry, these are of great value in estimating the direction aviation will take. These are selected primarily for value in thought or opinion.

opinion that aeronautics is of primary importance. It is not the dreamer who sees in the distant future hordes of planes, and future warfare will be mainly under the water and above the ground. Preparedness is the cheapest peace. Commercial aviation is now recognized as an indispensable unit in our business life.

The value of rapid mail transit is established, and I predict within the next few years all cities will be ably served by mail and express routes delivered through the air.

HARVEY PARNELL, GOVERNOR
—STATE OF ARKANSAS

Oakland, California, November 2, 1929.—Refer to your November issue: The premises of Leo T. Parker's article on employer's liability are as out of date as those of General Mitchell's article.

Contrariwise, war is gone as definitely as the entertainment-for-spectators phase of aviation.

JACK CHIPPING

Troy, Ohio, December 20, 1929.—After reading your most capable article, "Aeronautics—Where is the Industry Heading," in your December issue, and after trying to convince the general public that flying, after all, is not so difficult, I come upon the following statements which appear on Page 31 in your January issue.

"Medicine has ever kept abreast of man's activities, successfully coping with the problems present, and now the airplane presents a field of unusual demands, requiring the most extensive application of its art in increasing the safety factor. The human organism must be generously endowed with a finely balanced nervous equipment to surmount the stresses of rarefied air and barometric pressure. Latent defects of the apparently normal will be brought to the fore and *gravity will rule,* resulting in *death and great monetary loss.*

A searching *psycho-analysis* (My Gawd) must be made to determine the trends and potentialities and any hidden defects, either inherited or acquired, that may become magnified and motivate conduct from the insidious fatigue experienced in rarefied air. Fainting, dizziness, acute mania, and even epilepsy may first become manifest in the air. Reactions both muscular and visual, must be automatic to surroundings, supported by a resolute judgment and decision. *Delayed reactions* mean *disaster* in aviation. The temperament should be *cheerful* (!), stable, and self-reliant; the volition, energetic and controlled with a good tenacity of purpose. *A keen desire to fly is the prime requisite.*

(The parenthesis and italics are mine.)

Of course, the gentleman is writing about physical requirements for navy pilots, but your magazine is supposed to reach the general public, and I am quite sure that any poor devil who had hopes of flying before he reads the above, will certainly decide to become a shoe salesman after reading it.

My *constructive* criticism is that we are not misleading the public in telling them that *ordinary flying is easy.*

ROBERT E. LEES, SALES MANAGER
—THE WACO AIRCRAFT COMPANY

Los Angeles, Calif., Nov. 21, 1929.—Permission is herewith asked of the Editors of AERONAUTICS for the use of the appealing bit of verse entitled "Starbound" by Bessie Rainer Ford which appeared in the November issue, if they hold the copyright, or the address of the author if she retains the rights.

Upon my suggestion, Eme 'le'-California Composer, has set the word-picture to music, and the manuscript has been submitted to Galli-Curci through her management asking her use of it as an encore number in her Los Angeles Concert scheduled for December 3, providing permission for the use of words is received prior to that date. Inasmuch as Los Angeles is an air-minded town—at least according to the full-page advertisement of the Los Angeles Chamber of Commerce appearing in the November issue as well—the song should "go over" as Eme'le' has given it a melodic ethereality expressive of the lines.

Eme 'le' is a personal friend of Charles Wakefield Cadman, the well known California Composer, who extends her the privilege of reference as patron. Cadman will know Eme 'le' as Eme 'le' Wendell, Eme 'le' being her professional pseudonym recently established for purposes of her song publications, as in this instance.

Permit me to express my admiration of the achievement of the Art Director of AERONAUTICS. Although not technically interested I enjoy the visual vitality of AERONAUTICS for its atmospheric amiability and its air-i-ness of lay-out exceptionally expressive of its content. As in this case I bought the magazine for the compelling cover, finding the choice poem which has prompted this communication.

HELPH
—STUDIO OF THE SUNRISE SKYLINE
543 SOUTH VIRGIL AVENUE,
LOS ANGELES, CALIF.

Bismarck, N. D., Nov. 23, 1929.—We have your article "Where Is the Industry Heading" by William B. Ziff.

To one of buying class, it is so obvious what is wrong that it seems ridiculous why some people can't see it.

Did the manufacturers expect to keep on selling planes for $3,000.00 after all the buyers are supplied who can go out and make money with 'em? Where do they expect to get purchasers for little planes like the "Avian," DH Moth, Great Lakes, Trainer, etc., at $4,000.00 to $4,999.99? The prices are outrageous when one can buy a *real* car with *4* wheels and everything up to snuff for $2,000.00 (not $1,999.99). Just as S. Q. Noel says "cut the prices in half" and you'll see some airplane business, and the manufacturers will make good profits too. We'd all like to have new production motors too—we barnstormers—but we can't pay $1,999.99 for them.

The manufacturers of both planes and motors have got to "get down to earth" with their prices or there won't be any early recovery.

I've been selling planes for eight years.

F. B. IRVINE, MGR.
—N. W. AIRCRAFT CO.

Kansas City, Missouri, November 21, 1929.—Is it the policy of AERONAUTICS to be constructive or a destructive magazine? I do not believe there is any question but that you are constructive at heart, but I really believe that the article to appear in the December issue "Where the Industry is Heading" by William B. Ziff, is certainly destructive in print.

While you state that you diverge from the views of James Fitzpatrick, Vice-President of the Haskelite Corporation, in one point, it seems to me that you do in two. The first being, that you would like to have more talk of depression and second being that you do not agree with him in that we need more constructive publicity.

There is no question but that the Aviation Industry is basic and economically sound and that also there is no question but that this industry is going to expand. If AERONAUTICS did not concur with this opinion you would certainly discontinue your magazine at once, yet in spite of the fact that you are one of the leading Aeronautical magazines, you will print an article that would scare any layman from buying an airplane or from investing any of his time and his money in this industry.

That Aviation is not booming, is perfectly clear and there are several reasons for this condition. This is not the time of year that we can expect any large number of airplanes to be ordered. The method of constructing airplanes and also the present sales methods are far from perfect. There have been any number of poorly organized, fruitless air shows and I believe we have already learned the lesson from these. But fundamentally and basicly the industry is on a sound basis.

If the lack of confidence in Aviation and its various phases is alarming, as you state in your article, do you think this article will in any way help the situation, or will the person reading this article be more alarmed after reading it than he was before.

It is a good move on your part to bring an article such as this is before the industry, but I fail to see any good results that can be obtained by bringing an article like this in front of the general public. We have made our mistakes and they should be corrected. Let's get together and correct them. The public cannot help us in this matter.

Good constructive articles are always worth while, but I fail to find anything constructive for the laymen in the article which you will publish in December.

Why not put the paragraph in which AERONAUTICS states they believe with Mr. Vaughn that 150,000 airplanes will be in United States by 1934, as a beginning or second paragraph in this article instead of burying it near the end.

W. H. DIXON
—U. S. AIRCRAFT ENGINEERING SCHOOL, INC.

XUM

BOOKS OF THE MONTH

AERONAUTICS will be privileged to give information concerning books and publications relative to any phase of aviation on request.

THE Aircraft Handbook, fourth edition, by Fred H. Colvin and Henry F. Colvin. Published by McGraw-Hill Book Company, New York. Priced at $5.00.

Because the aeronautical industry has made such great strides forward in the past few years, as to make much in the first editions of The Aircraft Handbook obsolete, the authors collaborated upon this, fourth, edition, changing a great deal of each chapter on engines so as to conform with later developments in design, manufacture and maintenance. Some of the engines specified in the earlier editions are omitted and others added, making the volume thoroughly up-to-date. However, some of the old standbys, such as the Curtiss OX-5 engine and the Hisso, are still given attention although they are out of production.

Additional matter on construction and materials has been added, giving these chapters a completeness that they formerly lacked. Again, the chapter on "Trouble Shooting for Airplane Engines" is one of the highlights of the book carrying as it does practical information of servicing various motors.

All in all, we believe the book, treating as it does in detail problems that arise in the repair, building and maintenance of aircraft is well worth while and a valuable addition to the manufacturer's and mechanic's library.

OPPORTUNITIES in Aviation, by Walter Hinton, president of the Aviation Institute, U. S. A. Published by the W. W. Norton & Company, Inc., New York.

With the adventure-minded youth of the world turning to aviation as the last frontier, this book comes to fill a timely and very practical need.

Mr. Hinton—abreast of the industry as president of the Aviation Institute—knows the questions in the minds of the men who desire to get into the aviation industry and answers them with specific figures and definite facts.

This book answers such questions as "How can I get into aviation?" "What are the jobs?" "How should I go about it to get such work?" "How shall I learn to fly?" "How can I learn the business end of flying?" "How much pay may I expect?"

However, the book is not given over entirely to the youth whose ambitions are "up in the air," there is sufficient datum given so as to give manufacturers in other lines ideas that will aid them in participating in some phase of the aviation industry. For instance, there are listed 53 subsidiary or contributing industries in the manufacture and handling of a single plane. These extend from seed—grass, for airports—to glue and cement, for the building of the plane.

We can recommend this book to all persons contemplating going into aviation as a career.

AIR Men and Wings, by Lloyd George, editor of Airway Age, and James Gilman. Published by the Robert M. McBride & Company, New York. Priced at $3.50.

This book might be termed a comprehensive textbook for the boy. It contains a survey of flying from the beginning of aeronautics to the present, with excellent chapters on Aircraft in the World War and Lighter-than-Air Craft.

Not intended to be technical, this book is well worth while from the boy's standpoint and can be recommended as such.

HOW To Fly, The Pilot and His Problems, by Lieut. Barrett Studley, U. S. N. Published by The MacMillan Company, New York. Priced at $3.00.

The same man who wrote "Practical Flight Training" is the author of "How to Fly." The same attention to detail that characterized his first book is shown here and the person who wants to know the fundamental principles of flight will find much valuable and interesting information in this book. Of course, Lieut. Studley does not teach you how to fly, saying, "It has been said that learning to fly is very little harder than learning to drive a motor car. Anyone making such a statement can hardly have piloted a plane himself." However, he does offer information on how to go about learning to fly.

Lieut. Studley is an instructor in the Flight School of the Navy Air Station at Pensacola, Fla., and in this book he handles his subject with the authority with which he is qualified.

Especially good in his chapter on "Why an Airplane Flies." It goes into such detail that the ordinary person should have no difficulty in understanding the basic problems of the airman.

WEATHER and Why, by Capt. Ienar E. Elm, Air Corps Reserve, U. S. A. (Rtd.) Published by The David McKay Company. Philadelphia.

As long as fogs and rain and snow are a handicap to flying, so long will books on the weather and meteorology be of interest to people associated with the aeronautical industry either as pilots or passengers.

From the standpoint of those whose training was not directed to the technicalities of meteorology, this volume will probably be of much value, being a simple account of the fundamentals of weather.

Capt. Elm begins his book with a chapter entitled "The Atmosphere and the Wind," which serves as an introduction to his subject and a guide to later chapters on the various phases of weather. His last chapter on "Weather Forecasting" contains an explanation of weather maps and the current methods of predicting the weather.

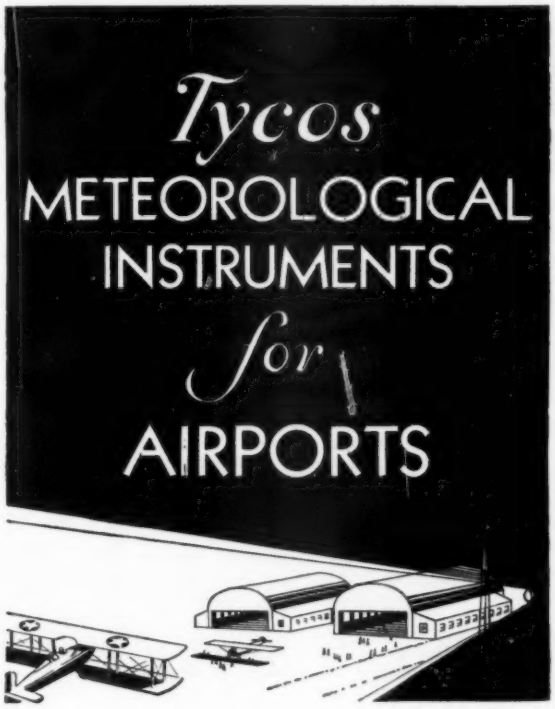
THE Navigation of Aircraft, by Lieut. Logan C. Ramsey, U. S. N. Published by The Ronald Press Company, New York. Priced at $4.50.

This volume covers in practical fashion the three divisions of navigation: piloting, dead reckoning and aerial astronomy. Although dead reckoning is stressed, it is done without injury to the other two divisions of aerial navigation.

Lieut. Ramsey's grasp of his subject is unquestioned, he having instituted and been officer in charge of the section of aerial navigation, hydrographic office, of the Navy.

XUM

Meeting Government Requirements for Accurate Weather Knowledge



"ALL airports, whatever their size, should be prepared to furnish information about the weather."

This is a familiar statement to airport owners and managers, taken from the Department of Commerce bulletin "Notes on Airport Management" and part of an article saying that minimum information should include the wind velocity, temperature and barometric pressure. Records of humidity, maximum and minimum temperatures, and rainfall are given as desirable.

TYCOS Instruments for airports fulfill these requirements. Seventy-eight years' experience manufacturing fine instruments has given Taylor Instrument Companies an enviable reputation for high grade products. TYCOS weather instruments are used by the U. S. Weather Bureau, U. S. Navy, U. S. Army Air Corps, and leading airports. TYCOS weather instruments are made of the finest material, built by skilled mechanics, and tested and retested to insure their accuracy.

Write for our booklet, "TYCOS Meteorological Instruments for Airports," which has been prepared by our aeronautical engineers and prescribes the proper instruments for every size airport.

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BRIEF NOTES FOR THE MONTH

A digest of the important information and developments of the month, compiled each issue for the busy executive with vital information classified and quickly accessible.

AIRPORTS

Following the installation of various types of test runways at the St. Louis Municipal Airport, B. Russell Shaw Co., Inc., are now preparing a plan for the entire development of the port, including a double system of runways for each wind direction as well as a budget for the expenditure of the balance of a $2,000,000 bond issue.

Fairfax Airport, Kansas City, won the honor of being the first airport in the United States to get to the dividend paying class when its directors approved a policy of paying 25 cents a share, payable March 30 to stockholders of record March 15.

A hotel for the Albany Airport is planned by Doyle Brothers. The hostelry will be of Spanish architecture and will have 25 rooms. Provisions for 50 more are incorporated in the plans.

The Austin Co. of California has been retained by General Aviation Corp., Ltd., to make a survey at Mission Airport, San Gabriel, Cal., preliminary to a $1,000,000 development there.

Plans for the use of Hog Island, near Philadelphia, as a combined air, water and rail terminal for Philadelphia, are being considered by the United States Shipping Board.

Plans are being made by the Aeronautics Branch of the Department of Commerce for the inspection of aircraft repair stations.

An airport, 800 yards square, has been established at Moose Jaw, Saskatchewan.

AIR MAIL

Air mail carried in November, 1929, showed a gain of 198,696 pounds over the same month in 1928. The total for last year was 623,161 pounds, 78,464 pounds less than for October.

A new southern transcontinental system of air mail lines and a new air mail line between St. Louis and New York, via Pittsburgh and Philadelphia, have been approved.

An experimental air mail service between Montreal and St. John, via Quebec and Moncton has been established by the Canadian postmaster general.

Four thousand tons of air mail were carried last year, Boeing System estimates.

ARMY & NAVY

Lieut. Harold C. King, formerly aerial machine gunner of the U. S. Air Corps, has been appointed sales manager of A. F. Stoeger, Inc., arms and ammunition specialists.

Capt. Lowell H. Smith, Army Air Corps, has been awarded the Distinguished Flying Cross for meritorious work as leader of the around-the-world flight in 1924.

DISTRIBUTORS

Schlee-Brock Aircraft Corp., Detroit, has been appointed distributors for the Inland Sport Monoplanes in Michigan, Indiana, Illinois, Minnesota and Wisconsin.

A permanent display of aircraft has been installed by Curtiss-Wright Flying Service in their office building at 1338 S. Michigan Ave., Chicago.

George B. Coles of Buenos Aires has been named to handle the distribution of Barling planes in South America.

FOREIGN

The Deutsche Luft Hansa and the Deutsche Fultograph Gesellschaft recently cooperated in transmitting pictures from the Berlin radio sending station to an airplane in flight. Practical use of the experiments is seen in the sending of weather maps to planes en route.

Guatemala has established a civil aviation department, to be a part of the ministry of public works. It is expected to harmonize and coordinate the activities, plans and services of the various aeronautical organizations.

The Australian Aerial Services, Ltd. and the Commonwealth Railways are completing arrangements for a combined air-rail service from Sydney to Perth, Australia. The journey of 2,187 miles will take 35 hours.

Contract for carrying air mail between Guatemala City and Flores, center of the chicle producing territory of northern Guatemala, has been granted to the Pickwick Latin American airways.

Compania Colombiana de Rutas Aereas, S. A., has been organized to operate commercial airplanes and seaplanes throughout the country.

GLIDERS

'Gliding leads to flying," Col. L. H. Brittin, president of the Northwest Airways and N. G. A. director, declared in an appeal to the aircraft industry to support glider activity. "An army of glider enthusiasts would be an army of aviation enthusiasts," he continued. "And an army of aviation enthusiasts would constitute a tremendous potential market for airplanes—a market which is today needed by the American aircraft industry."

The Rhoen - Rossitten - Gesellschaft, leading gliding club of Germany, recently fitted a tail-less glider with an 8-10 h.p. motor and a pusher propeller. The resultant plane proved a good climber and attained a speed of 120 km. per hour at 1,000 feet.

Thirty thousand spectators attended the Detroit Glider Carnival when fifteen motorless ships, piloted by young flyers from the University of Michigan and other schools, competed for trophies offered by the National Glider Association.

Forty-three glider clubs are reported in process of formation throughout the United States. Two new clubs were added to the N. G. A. roster when applications were received from Mt. Clemens, Mich., and Fernandina, Fla.

INVENTIONS

A specially constructed wind-tunnel has been put in operation by the Tubular Aircraft Corp. The tunnel is of the free type, two foot, and works at a speed of 45 m.p.h., which speed will be increased to 110 m.p.h. shortly.

The Notrus Hangar, erected at the plant of the Great Lakes Aircraft Corp. at Cleveland, withstood a snow test of 30 pounds per square foot and a wind test of 90 miles per hour. The hangar is arch-shaped, being 76' wide and 27' high.

LEGISLATIVE

Representative McLeod of Detroit has presented three measures to the house, all looking toward the advancement of aviation in the United States. The measures are (1) H. R. 6616, providing for the establishment of a department of aeronautics; (2) H. R. 6609, providing for a $100,000,000 revolving fund to be loaned airplane manufacturers and the promotors of air lines, and (3) H. Res. 82, providing for the

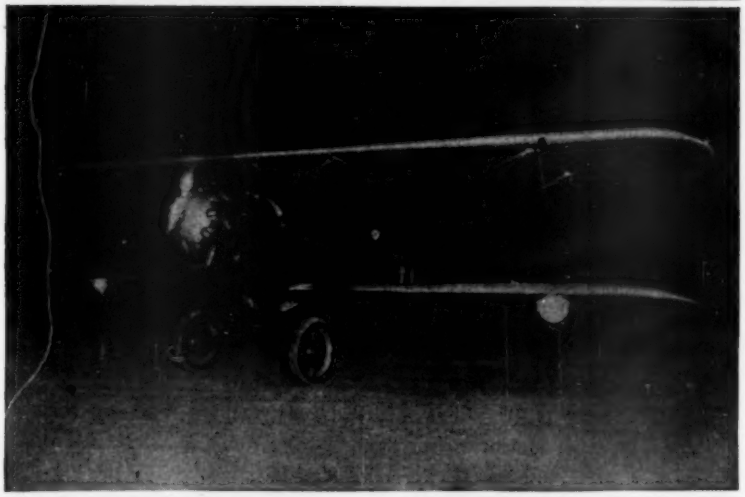
Use of the Gosport communication system enables an instructor to direct a student's training while in flight.

In all acrobatic flying at the Spartan school both instructor and student wear modern parachutes as shown here.

A Spartan training plane, photographed from a companion craft, during formation cross-country flight training.

Students in advanced classes get valuable flying experience in this modern Spartan school cabin transport.

Spartan C-3-165, powered with the Wright "Whirlwind Five," one of the types of training planes used by Spartan.



SPARTAN TRAINING SPECIALIZES IN EVERY FORM OF FLYING

FLIGHT training at the Spartan School of Aeronautics introduces the student-pilot to every form of flight he will experience as a commercial pilot. First he learns the simpler maneuvers and masters landings in a dual-control training plane equipped with the Gosport system of communication between instructor and student. Steadily he progresses to solo cross-country work, cabin plane flying, solo flying in a high-speed bi-plane, acrobatics and finally, night flying.

The Spartan School of Aeronautics is one of few in America licensed by the Department of Commerce as Transport Ground and Flying school. This requires that all instructors and all training planes be Government-licensed and that every Spartan course of instruction measure up to Government standards.

COURSES—Spartan offers three courses qualifying graduates for license examinations in the following grades: Private, Limited Commercial or Transport Pilot. Each course includes technical, theoretical and business subjects.

Two other special courses qualify graduates as expert Mechanics or Welders.

EMPLOYMENT SERVICE—Spartan operates an employment service for students. Openings are investigated and expert assistance is given the qualified graduate in making a professional connection.

FREE AIR TRANSPORTATION—Southwest Air Fast Express operates trimotored Ford planes to Tulsa from St. Louis, Kansas City and Springfield, Missouri; Oklahoma City, Oklahoma; Dallas, Fort Worth, Wichita Falls and Sweetwater, Texas. Spartan will pay the air fare to Tulsa from any of these cities for those enrolling in the Transport or Limited Commercial course, or half the air fare for those enrolling in the Private Pilot or Mechanic's course.

SPARTAN SCHOOL OF AERONAUTICS
TULSA, OKLAHOMA

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SPARTAN SCHOOL OF AERONAUTICS, TULSA, OKLAHOMA.

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☐ Illustrated booklet describing all Spartan courses. ☐ How I may make use of the Spartan extended tuition payment plan. ☐ Particulars concerning your offer to pay my air transportation fare to Tulsa.

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establishment of a standing committee of aeronautics of 17 members.

Denial that the Department of Commerce proposes a change in policy on regulations that would unfavorably affect the further use of OX-5 engines was made in a telegram from Clarence M. Young.

MISCELLANEOUS

A. Wittnauer Co. points out that "every record-breaking aviation feat, of this year, such as Williams and Yancey's flight from Old Orchard to Rome, the flight of the Graf Zeppelin around the world, of Assolant, Lotti and Lefevre from Old Orchard to Paris, the trip to Jiminez and Iglesias from Seville to Bahia, and the endurance flight of Miss Elinor Smith were accomplished with Longines timing equipment exclusively." Cdr. Byrd's timing equipment also is Longines.

Exports of aircraft from the United States for the first ten months of 1929 showed an increase of $3,016,602 over the full year of 1928. Export of aircraft engines showed an increase of $556,272 for the same period, while aircraft parts, except tires, increased $524,300. The total exports of aircraft for the ten months amounted to $4,775,235. Mexico was the leading buyer with planes costing $1,504,001.

A "fly-it-yourself" service with instruction features on three different types of planes has been announced by the Schlee-Brock Aircraft Corp. of Detroit. The service will be available to pilots in Detroit, Minneapolis, St. Paul and Duluth.

One of the most elaborate three-day reunions in the history of the American Legion is planned by the Aviation Post, Chicago, for Feb. 20 to 22. An air circus, free to the public, is planned for the airports in Chicago.

Bullard-Davis, Inc., Air-Kit has been approved by the Department of Commerce. This first air equipment is contained in an aluminum box and weighs 18 ounces.

Model SE4000 Travel Air biplane, equipped with Wright J-6, 165 h.p. engine and Edo Model 2663 floats has been awarded the Department of Commerce approval.

Requests for tickets for the second annual New York Aviation show, opening at the Grand Central Palace, Feb. 7 is reported as more than double that of 1928.

Ten Curtiss Conquerer engines and spare parts, valued at more than $100,000, have been ordered for shipment early this year by Soviet Russia.

A formidable number of foreign aviation manufacturers will utilize space at the International Aircraft Exposition at St. Louis, opening Feb. 15.

The Circus engine has been adopted by the Rankin Systems, Inc., Ogden Aircraft Co. and Victor Aircraft Corp.

The Diesel airplane engine "SL 1" has now completed trial-flight tests of more than 60 hours.

PERSONALS

Charles L. Lawrence, president of the Wright Aeronautical Corp. and vice-president of the Curtiss-Wright Corp., has been appointed to the advisory committee of the Daniel Guggenheim School of Aeronautics of New York University.

George J. Kilgen, vice-president of George Kilgen & Sons, St. Louis, has been named to the Midwest Group of Advisory Board members of the Aircraft Finance Corp.

Governor Horton of Tennessee has signed the bill which creates a division of aeronautics in the department of highways and public works.

William B. Mayo, chief of the airplane division of the Ford Motor Co., was elected president of the National Gliders Association.

Miss Novetah Holmes has joined the Sikorsky Aviation Corp. as assistant publicity director.

Albert E. Hastings has been appointed sales manager of the Bowlus Sailplane Co.

Glenn Muffly has been named to the executive staff of American Cirrus Engines, Inc.

PRODUCTION

Ford Motor Company announces a new tri-motored, all-metal transport plane to be known as the 7-AT type. The most essential difference is the substitution of two Wright J-6 motors for two of the three Pratt and Whitney Wasps. The nose motor will be a Wasp.

Plans for the building of the largest passenger carrying plane in the United States are under way at the Emsco Aircraft Corp., Downey. The plane is to have a wing-spread of more than 100 feet, and will be powered by four motors.

Northrop Aircraft Corp., Glendale, Cal., plans to begin construction of a new type of metal airplane upon completion of a new $75,000 plant at United Airport, Burbank.

Nicholas-Beazley Airplane Co., Inc., Marshall, Mo., announce a net profit of $87,828.91 for the first six months of 1929.

SCHOOLS

Frank N. Bonta, engineer and designer, has been engaged by the Edgewater Flying Club, Inc., Chicago, to reorganize the club's school curriculum to meet the government's authorized and rated school requirements for flight instruction.

Motion pictures are being utilized by the ground classes at the Marshall Flying School, Inc. Films shown are obtained from the government. They depict various phases of aircraft construction and operation.

Jefferson School of Aviation has organized a Junior Aviation Club for Jefferson City boys between the ages of 8 and 16. The club will build and fly model airplanes under the supervision of the school.

The Universal Aviation Schools are giving their flight students $2,500 in life and disability insurance, which protects them for any accident arising while under the jurisdiction of the school.

Approximately 140 students are registered for the course in Aeronautics offered at the University of Minnesota and required by the Navy department preparatory to flight and commission training.

A student club building, designed to accommodate 50 students of the Jefferson School of Aviation, has been completed. Private rooms for transient pilots have been provided.

Park's Air College Transport students are to be given seven hours instruction in a Wasp engined, tri-motor Ford plane, recently ordered by the school.

The Spartan School of Aeronautics has inaugurated a special branch for the teaching of acetylene welding.

Ninety-five per cent of Park's Air College graduates are at work in the aviation industry, a survey shows.

The Lincoln Flying School of Lincoln, Neb., has been appointed dealer of the Barling NB-3 monoplane.

TRANSPORT

Colonial Airways System has cut its rates between New York and Montreal. The new price is $33.40, a reduction of $16.60. Other new rates are New York to Albany, $14.70; Albany to Montreal, $19.70; and Buffalo to Toronto, $12.50.

Scheduled operations comprise less than one-sixth of the civil flying in the United States, the remainder consisting of non-scheduled commercial services and private flying, Clarence M. Young estimated recently.

William B. Holland, Universal Aviation Corp. pilot, flew from St. Louis to Chicago (250 miles) in 1 hour and 35 minutes, 55 minutes ahead of schedule. He flew a Super-Universal Fokker.

Aural-type radio range beacons on the Cleveland-New York airway are given credit for assisting materially to reduce delayed and interrupted schedules of air mail.

Three "flag stops" have been created by the T. A. T.-Maddux Air Lines on the air-rail coast to coast route. The three are located at Vandalia, O., St. Elmo, Ind., and Terre Haute, Ind.

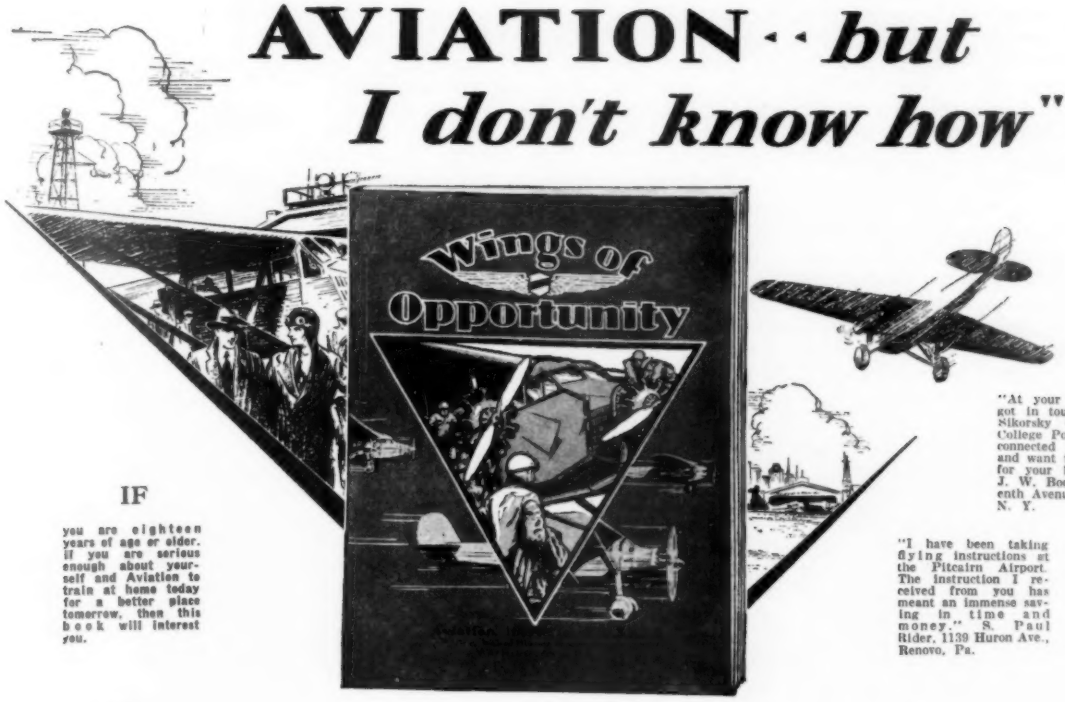
Twice-a-day service is now being on the Seattle-Vancouver route of the Alaska-Washington Airway. Introductory rates of $16 one-way and $29 round-trip were featured.

Universal Aviation Corp. has discontinued passenger service on their St. Louis - Kansas City - Omaha mail planes.

XUM

This Free Book .. is for the Man who says:

"I'd like to get into AVIATION .. *but I don't know how*"



IF

you are eighteen years of age or older, if you are serious enough about yourself and Aviation to train at home today for a better place tomorrow, then this book will interest you.

"At your direction, I got in touch with the Sikorsky Company at College Point. I have connected with them and want to thank you for your help." Paul J. W. Boehn, 47 Seventh Avenue, Brooklyn, N. Y.

"I have been taking flying instructions at the Pitcairn Airport. The instruction I received from you has meant an immense saving in time and money." S. Paul Rider, 1139 Huron Ave., Renovo, Pa.

Walter Hinton

was pilot of the famous NC-4, the very first plane to fly the Atlantic; he was the first Aviator to fly from North to South America; he was first to use a plane for exploration. During the war he was one of the Navy's crack flying instructors. Over 400,000 miles of flight under every conceivable condition, and over thirteen years of intensive aeronautical experience are behind his method of training.

To some men Aviation means spirals, banks, loops, a rush of wings, a roar of motors, a challenge to red-blood.

To others it means booming factories, busy air ports, expanding commerce, mounting sales, a challenge to ambition.

It does not matter WHY you are interested in Aviation—whether you think of it in terms of action in the air or action on the ground. It offers you an immediate opportunity and a big future. And Walter Hinton can help you realize both.

What is Walter Hinton's proposition? . . . It is three-fold:

First, Hinton puts you through a thorough course of training right at home, which completely covers Aviation's "ground-work." Flyers must have more than nerve and enthusiasm. Specialists in factories and at air ports need more than determination and energy. *Everybody*, in *every* branch of Aviation, needs—and *must* have—*training*.

Second, Hinton backs up his course of study with a personalized, man-to-man service. He gives you special coaching on the subjects that are of particular interest to you.

Third, he helps you capitalize your training. If you want to fly, he directs you to a properly qualified flying school, and arranges for a reduction in your tuition. If you want a job, he puts you in touch with a prospective employer. If your present occupation is not what you would like it to be—if the future possibilities of your job fail to measure up to the future possibilities within yourself—if you are EIGHTEEN years of age or older—then Hinton wants to present YOU with a copy of his book, "Wings of Opportunity."

The cost of Hinton's course and service is small. The return in dollars and opportunity is practically unlimited. What Aviation wants today above everything else is men with the *right kind* of training. Aviation will want YOU once you have *that*.

Aviation Institute of U. S. A.

WALTER HINTON, President

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LIGHTER THAN AIR [*Continued from page 34*]

and their efficiency was constantly impaired; troops, airplanes and guns were retained for home defense far in excess of the effort required from the Germans to make these attacks, and despite subway drills, increased fire protection, searchlights, nets and the like, the morale of the British nation was, to say the least, not improved by these raids, on which a total of 9,000 bombs, weighing some 280 tons were dropped.

A maximum of 11 Zeppelins participated in any one raid. They had barely sufficient fuel to make the 1,000-mile journey from their bases in Germany to London and return, and could barely attain an altitude sufficient to clear the British nets and AA fire. They carried an average bomb load of say, five tons. Compare these figures with those of the Navy ZRS4 which has a cruising range of 9,000 miles with a useful load of 91 tons.

It is certain that the modern dirigible is a long range weapon to be seriously considered in any war.

At the end of the war Zeppelin officials at once turned towards their long-cherished dream of encircling the world with commercial dirigibles. By the fall of 1919 the Nordstern and Bodensee were completed and operating commercially in Germany. They were small in size, but remarkably efficient. The inter-Allied commission, however, soon prohibited all Zeppelin development. The Nordstern was delivered to France and the Bodensee to Italy. In accordance with the terms of the Armistice the Zeppelins L-64 and L-71 went to England; the L-72 and the LZ-113 to France; the L-61 and the LZ-120 to Italy; the L-30 to Belgium and the L-37 to Japan. The LZ-113 was renamed the Dixmude by the French. It established a world's endurance record of 118 hours, and was subsequently lost over the Mediterranean in 1923 with all hands. The remainder of these ex-German dirigibles were allowed to deteriorate in the hangars of their new owners, though through this allotment foreign engineers were enabled to obtain full information concerning Zeppelin design and construction methods. Since the war the Zeppelin works have also turned out the Los Angeles for the United States, and the Graf Zeppelin, which has attracted much attention by trans-Atlantic flights, long trips over Europe, and, more recently, by flying around the world. The Graf Zeppelin gained considerably in performance over previous dirigibles by use of a new dural which is 20 per cent stronger yet weighs no more than that previously used.

In 1914 the Zeppelins had a capacity of less than a million cubic feet of gas, a speed of about 50 knots, and a ceiling of some 10,000 feet. By 1918 they contained 2,200,000 cubic feet of gas, had a ceiling of 20,000 feet or more and a high speed of from 70 to 80 knots.

The Allied war-time lighter-than-air effort was centered around blimps and kite balloons. French, Italian, American and British non-rigid and semi-rigids were found to be especially suitable for escorting convoys and guarding against submarines because of their long range and their ability to hover near a convoy without awkward circling. Kite balloons were widely used for observation along the various battle fronts and on battleships for spotting stations. In the U. S. pilots (Navy) were trained at Akron and B-type blimps did some 13,600 hours of patrol without a fatality.

English airship development started with the Mayfly which was completed in 1911. This dirigible had a capacity of 700,000 feet, two engines, good form and excellent arrangement of the control and engine cars. It accomplished the first successful mooring to a mast during its trials and was far in advance of its contemporaries. In 1913 the British started a rigid, the R-9, but this was abandoned before completion because the performance of the Zeppelins made British engineers realize that they were far in advance of the R-9 in design.

After examining the German L-33 which was captured almost intact in England after a forced landing in 1918, the R-33 and R-34 were built, virtually copies of the L-33. No duralumin was available in England, so that wood and steel were used for girders and frames. In 1919 the R-34 flew from England to Mineola, L. I., and return. In 1925 the R-34 returned safely from a mooring mast escapade similar to that of the Shenandoah in the preceding year. The ill-fated R-38, under construction for the United States when it fell in flames in 1921, was similar to the R-34 in design. The R-33 and R-34 have been retired from service because of their age, and the British commercial rigids, R-100 and R-101, were planned to take their place.

Italy has been prominent in lighter-than-air for its development of semi-rigids. Outstanding incidents are: The flight of the Norge from Spitzbergen to Teller, Alaska, via the North Pole in 1926; the loss of the Italia on an Arctic Exploration flight near Spitzbergen in 1928, with a remarkable sequence of after events; and the burning of the Roma, which had been purchased by the U. S. Army, when it struck high tension wires near Norfolk in 1922.

The first U. S. rigid airship was authorized by Congress in 1916. In 1918 all rigid airship development was assigned to the Navy. Much valuable data was obtained from the Zeppelin L-49, which was forced to land intact in France in 1917 and from the L-33, which landed in England and was partially burned in 1916. From this data, altered and improved, the design of the ZR-1 was conceived. This rigid was completed at the U. S. Naval Air Station, Lakehurst, N. J., in September, 1923, and christened the U. S. S. Shenandoah. Parts for the Shenandoah were fabricated at the Naval Aircraft Factory at Philadelphia and shipped to Lakehurst, which is now the center of Navy lighter-than-air training and experimental work.

In order to obtain a second rigid for the United States the purchase of the British R-38, then under construction, was authorized in 1920. This ship, which was redesignated the ZR-2, was patterned after the German L-33. On August 24, 1921, on its fourth trial flight, while still in British possession, it broke into two parts due to failure of the structure in the rear of the after engine car and burned. Sixteen officers and men of the U. S. Navy, including Commander Maxfield, our senior L.T.A. officer, lost their lives.

In connection with German reparations, arrangements were made in 1921 to have the Zeppelin works construct a third rigid for the United States. This ship, the LZ-126, was redesignated ZR-3 and subsequently christened Los Angeles. It was flown across the Atlantic by a German crew, arriving at Lakehurst on October 15, 1924, having made 5,066 miles from Friedrichshafen in 81 hours at a speed of 67 m.p.h.

In the United States the development of non-rigids (blimps) has resulted in the Army TC-type and the Navy twin-engined J-type, both of which are very satisfactory for scouting, patrol, and training for rigid airship duty.

In 1923 the Shenandoah made a most successful trip from Lakehurst to San Diego, Seattle, and return. In January, 1924, the Shenandoah broke away from the mooring mast at Lakehurst during a severe storm and after a thrilling struggle against the elements made her way back to Lakehurst, slightly damaged, but little the worse for her experience. In the fall of 1925 the Shenandoah was caught in a line squall, in which violent and opposite currents of air occur, over Ohio. The tremendous twists imparted

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to her structure broke it in two, and the "Daughter of the Stars" fell, resulting in the death of 17 officers and men.

The operations of the Los Angeles, under Lieut. Commander Rosendahl, U. S. N., have been most successful. "The big silver pig," as she is familiarly known in the Navy, has five 400 h.p. Maybachs against the five 300 h.p. Packards of the Shenandoah, and is bigger and stronger than her ill-fated companion. The Los Angeles has crude accommodations for 20 passengers in addition to her regular crew. By the terms of the reparations agreement under which she was acquired, her use for naval purposes and Fleet exercises was prohibited. She has made some 200 flights, including many overland and overwater trips of considerable duration; has flown to Panama and return; made two flights to Bermuda, and one to the Virgin Islands; and in addition has carried out much important experimental work leading to future rigid development, including many moorings to masts at Lakehurst and on the Patoka, and has served to train the members of our Naval L.T.A. service.

The course of instruction at Lakehurst includes ground school work in the history of L.T.A., aerostatics, aerodynamics, aerology, gases, airship construction and design, maintenance, engines, airmanship, navigation, radio, gunnery, bombing, etc. The Navy Parachute School is also located at Lakehurst. Practical work in the L.T.A. course includes experience in kite and free balloons, non-rigid J-type blimps, and in the various duties on board the Los Angeles in flight and when moored, and in the handling, mast and ground crews. At least 200 hours in the air are necessary before the designation of Naval Aviator-Airship may be granted.

The piloting of an airplane is an individual task, whereas the piloting of an airship required efficient leadership and a highly trained crew, each member of which is expert in his duties, and perfectly coordinated with the other members, and a sizable, well trained ground crew to handle the ship in mooring, at the mast, and in going in or out of the hangar. Strong side winds often complicate this latter task which is accomplished by towing lines pulled by mechanical dolleys on tracks, plus other lines manned by the ground personnel.

Airships do not maneuver rapidly; they carry large loads in enclosed cabins and are fairly steady, making them ideal for passenger carrying; long range and their ability to hover make them of great value for use as over-sea scouts or bombers. The advent of helium has removed the fire danger and greatly reduced the hazard of machine gun attack and AA fire in war. In addition new war types will be well protected against enemy aircraft by machine guns properly placed, and will carry several fighting or scouting planes which can be instantly released and which, recent experiments with the Los Angeles show, can be readily "hooked on" and received back on board.

The principal problems in airship operation are those of ballast, avoiding the loss of gas by valving, and gas pressure and temperature. As fuel is burned in flight its weight is lost, and the ship, thus becoming light, tends to rise. In old rigids this tendency was overcome by valving gas, with the result that finally the rigid no longer had any reserve buoyancy and was forced to land. Water recovery apparatus now recovers most of the weight of the fuel burned from the engine exhaust gases, thus solving this problem to a large extent. In the Graf Zeppelin blau gas or ethane, rather than gasoline, is used for fuel. These gases are the same weight as air, and hence no change in buoyancy occurs as fuel is burned.

Gaseous fuels are carried in bags under the lifting gas cells of the airship; they avoid concentration of weights in one small portion of the structure, and eliminate changes of trim as fuel is burned and do not increase the fire hazard. As a dirigible rises the external air pressure decreases. At altitudes this might cause gas cells to burst, were not automatic escape valves into ballonets provided to relieve excessive pressures. Similarly, sharp increases in temperature cause the gas to expand, increasing the pressure, and vice versa. In airships in flight the vertical (steering) and horizontal (altitude) controls are separately manned, gas pressure and temperature must be constantly watched, ballast is always ready for instant release, and for economical prolonged operation gas and ballast must be conserved. The main ballast usually consists of water in quick-dumping tanks. In weighing off the ship is brought out of the hangar, excess ballast is removed until the ship is slightly light, the handling crews let go, and the ship starts its engines, rises and gets underway. In landing the ship hovers over the field at low altitude, drops its handling lines, is pulled down and towed into the hangar.

Advancement in dirigible design has been slow because progress has not been steady, and because not enough of them have been in use. Only those closely connected with lighter-than-air realize what great strides have been made, especially in the past few years, and how near solution most of the problems actually are. Dirigibles are not fair weather ships. They can and have survived storms of the severest intensity. They will benefit, as will all aircraft, by a more extensive radio weather service to aircraft in flight. They are being built of greater strength and power to better enable them to fight storms, will be large in size to lift their crew and cargo, and will be fast enough to avoid rapidly moving areas of bad weather. It has been found that a somewhat "fatter" shape (greater diameter) than heretofore used lends itself to these characteristics.

In accordance with these theories as proven by the work of the Los Angeles and the recent spectacular trans-Atlantic and around-the-world flights of the Graf Zeppelin, the Goodyear Company is now building for the United States Navy the ZRS-4 and ZRS-5, sister ships of 6,500,000 cubic feet capacity, to carry full war equipment including five planes to be housed within the hull. In these new Navy types the engines and cars will be located within the hull and

The following table gives the salient characteristics of the LZ-112, perhaps the best war-time Zeppelin, and more recent airships now operating or under construction:

	LZ-112	Los Angeles	Graf Zeppelin	R-100	ZRS-4
Capacity	2,400,000	2,470,000	3,708,000	5,000,000	6,500,000
Length	743	658	776	724	785
Maximum Diameter	78.4	90.7	100.1	131.7	133
Gross Lift (tons)	73	76.5	125	252	201.5
Useful Load (tons)	17.5 (war-equipt)	30	64	120 est	91
Engines	5	5	5	6	8
Horsepower	2,030	2,000	2,750	4,200	4,480
Speed	75	78	78	82	73
Range	4,500 miles at full power	3,960 miles at full power	5,300 miles at full power	4,000 miles at full power	9,180 miles at cruising speed

NOTE: 1. Lesser range of R-100 gives it greater useful load.
2. War equipment of ZRS-4 gives it smaller useful load than that of the smaller R-101.
3. Note the steady gain in useful load.

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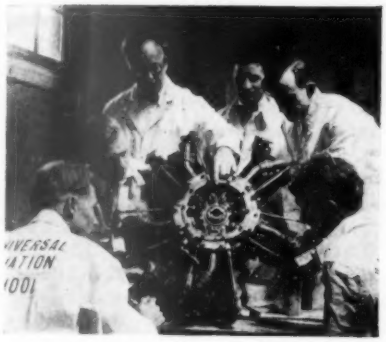

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the propellers driven through gears, thus reducing resistance and increasing speed; the ZRS-5 will probably be equipped with Diesel engines, affording a much greater range, and the operations of these ships with the Fleet will rapidly develop airship tactics and war employment. The Goodyear Company is also building two commercial dirigibles of similar capacity with accommodations for 100 passengers for use between the Pacific Coast and Hawaii. In England two 5,000,000 cubic feet dirigibles, the R-100 and R-101, are expected to be used between England, Egypt and India. The Zeppelin Company has announced plans for a super-Zeppelin of large size.

Experimental all-metal rigids are being perfected at Detroit, Mich., for the U. S. Navy and at Glendale, Calif., for commercial use. The former craft, the ZMC-2, is 150 feet long, contains 200,000 cubic feet of gas, and carries a crew of four, with a radius of 600 miles at 62 knots. To popularize lighter-than-air the Goodyear Company operates a number of small blimps, such as the Volunteer at Los Angeles, and the Pilgrim in the East, for exhibition flights and training, and maintains a commercial L-T-A school at Akron.

In view of these recent events and present plans surely the vision of lighter-than-air enthusiasts—that of a trans-oceanic network of luxurious passenger and express dirigibles, connecting at terminals with trans-continental heavier-than-air lines—is not absurd or even far fetched.

TRAINING GLIDER PILOTS [*Continued from page 24*]

school work in theory of flight, aircraft construction, and aerology, he is given three "gulls" and becomes a licensed glider pilot.

In launching gliders at the Cape Cod school, the initial projective force is furnished by what amounts to a huge slingshot. On the nose of each glider is an iron hook through which is run a long powerful rubber rope, covered with cloth to prevent wear on the rubber. The pilot straps himself in the seat of the glider while two members of the ground crew hold the ship down at the tail and two others "walk away" with the two ends of the rubber rope.

At the command "let go," given by the pilot, the two men at the stern release their hold, and the glider, which is in the apex of the rope just as a stone is held in a drawn slingshot, shoots away into the air, the rubber rope dropping from the hook the moment the tension is released.

At present the school has a fleet of 18 gliders in operation and although they were imported from Germany they have been assembled by the students themselves, under surveillance of the three German instructors. The practice of student-assembly offers an excellent opportunity for practical work in structure and rigging of aircraft. Pine and spruce are used for struts, ribs, and spars, and the construction of gliders is similar to that of motor planes, save that the frame and even the fabric covering is lighter. Added efficiency is given to the wings by the graceful tapering ends, and the fact that many power planes are now designed with the tapered glider-type wing is evidence of the practicability of improving power planes by adopting features that have made the present-day sail-planes so efficient.

Following the custom current in Germany, where over 3,000 school boys received official instruction in gliding last year, the students at the South Welfleet Glider School are separated by age into two divisions: Boys from 14 to 17; and older men. In the latter division many licensed airplane pilots are found, and the number is steadily increasing for the value of glider experience is rapidly becoming recognized by motor-plane pilots.

Although the school was founded primarily to give the male youth of this country a safe, yet sporting, way to grow wings, so many women made applications for the training that next year will see the facilities sufficiently enlarged to offer them a chance to find their wings, and win the coveted "gulls."

SEADROMES [*Continued from page 22*]

register as such or obtain clearance papers or carry the flag of the nation under which they are registered. Because this is so, their status becomes the more puzzling. Without registration and with due respect for the freedom of the seas, who is to have jurisdiction over them and to whom shall they turn for protection in times of difficulty?

As an example, suppose a vessel collides with one of them on the high seas, to whom can the owners of the seadromes apply for redress? If a foreign power decides that their location is undesirable from the standpoint of military defense and threatens to sink them or blow them from the sea, to whom shall their owners turn for help?

The more the problem is considered the more involved it becomes. It is an apparently simple matter to construct floating landing fields and anchor them at sea and put in service air lines running on schedules between the United States and other countries, but there must, apparently, be some basis for settling the various problems that arise.

Since the seadrome is not a vessel, as it does not move or carry freight or passengers, but is stationary, then is the seadrome an island? If the seadrome is an island, then must it be regarded internationally according to the rules governing an island?

If the seadrome is operated by a British company and owned by an American company, just what is its nationality? Regardless of its ownership and its operating membership does the seadrome itself have a nationality? If not, who ever heard of an island without nationality, once it was discovered?

If a seadrome is not a vessel but a kind of island, but without nationality, and a company was formed thereon in a legal sense, just what would be the status of that corporation as to responsibility?

To pursue the question logically, is it possible for the seadrome to be independent of all powers, having a status of its own, and to all intents being a state in the political sense? Thus the seadrome would have to obtain recognition of the powers and its agents would have a diplomatic status.

There are still other angles: A seadrome must keep within the law—its own law, possibly—for the convenience of its guests, who would wish property and life safe at all times. Thus there is the problem of police powers and such powers must proceed from some source recognized as having full and ultimate jurisdiction. If a seadrome were robbed, would it be considered piracy on the high seas or would it be considered merely as housebreaking?

If the seadrome is an island, what would Great Britain or the United States or France do if an individual thought to be a criminal fled to one? The fleeing individual would be a fugitive from justice, but does the seadrome provide immunity as long as the criminal sought to stay there?

As far as the inventor of the seadrome

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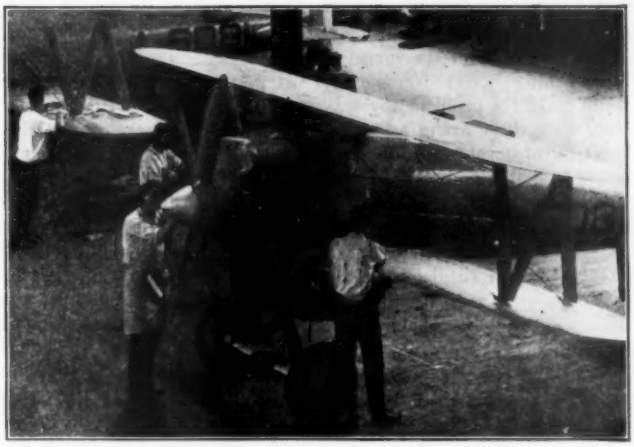

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idea is concerned, Mr. Armstrong indicates that he considers these great floating fields as coming under the jurisdiction of the United States. However, that does not make the problem any easier to solve, since there arises a host of military and naval questions.

With a seadrome anchored about 400 miles from the continent of Europe, will the nations there wish to have an extension of Uncle Sam's arm so close to their shores? With a suspicion of the wealth of this nation, will not the seadromes be considered as possible military stations in time of war?

Should the United States undertake to secure other powers that the seadromes were never to be used in a military sense, what would happen if in a time of stress another power should seek to sink the seadrome or to occupy it for its own purpose? Would this nation consent? The seadrome could not be considered an island in the usually acquired sense, nor could it be considered continental territory, yet its value in time of war could not easily be overlooked, and no nation would be willing to see the long arm of another reaching toward it in such a fashion.

If a seadrome belonged to the United States, by virtue of its ownership, could its employes be taxed as are other nationals? Or, on the other hand, could the seadrome organize for the purpose of having a police force of its own, levy taxes for upkeep in addition to rentals? As a fantastic thought but not escapable by the logic of the reasoning, could a series of seadromes, connected by modern methods of communication, such as airplanes, radio, cable and telegraph, organize as a state and ask for admittance as such within the Union? Or could they become a nation instead?

With the seadromes having a large number of employes, what would be their status as to voting? Could the income tax laws reach them? Would it be possible for them to ballot by mail? And what stamps would their mail carry?

There seems to be one problem that is solved at the beginning, and its inventor and his backers have not been unmindful, and that relates to the question of the seadrome's status under the prohibition laws of this nation. According to all the rules of international procedure the seadrome cannot be made a dry area; prohibition could not be enforced legally 400 miles at sea. This fact is recognized in the plans that call for hotels, restaurants and bars for the passengers seeking various refreshments while awaiting passage or airplanes in other directions.

There seems little doubt as to the seadrome's physical ability to supply the need. Dropping easily from the skies to a man-made island, level, steady and comfortable, the passenger may enjoy his meal and prepare to make another jump over a well-marked, weather-known route, where even a forced landing would not be serious, as intermediate stations are planned for and cries of help will be answered by fast seasleds, capable of reaching any spot within a short time and able to make repairs.

These great seadromes, according to extensive tests, will not be affected by the greatest storms or even hurricanes. Extending more than a hundred feet below the surface of the sea, where giant pontoonlike devices will reach water that is forever quiet and stable, and rising nearly a hundred feet above the sea, even the waves will not dash over their smooth decks. When the weather reports gathered by the series of seadromes is known, it will be possible to hold planes from making hazardous trips, even as the air mail is halted at difficult seasons.

Thus there arises a genius within man to fill a need. The need is expressed in the annihilation of space and the desire for rapid transportation. It is but partly filled by the fastest of ocean lines. The prize is a share of the wealth paid out for ocean transportation. As for international law, it will probably be well in the rear attempting to keep within hailing distance of the seadrome problem, while in the meantime new uses and new placements of ocean landing fields will be carried forward and the "freedom of the seas" will become the problem of the seas and their uses.

The question of seadromes being a menace to marine navigation in fogs and storms arose during the early discussions of the proposed airway to Europe. However, it was definitely decided that the searchlight beacons, fog sirens and radio devices to guide the sea-going planes to safe landings would warn ships of the imminence of the seadromes.

Mr. Armstrong has had in his preliminary plans the good will and aid of the four Government branches interested in aeronautics—the Navy Bureau of Aeronautics, the Army Air Corps, the Aeronautics Bureau of the Department of Commerce and the National Advisory Committee for Aeronautics, the latter an independent institution which acts in an advisory capacity for the first three.

The inventor recently made a trip to Bermuda, where he obtained promises of cooperation from the Governor General, the Colonial Secretary, the Legislature and Chamber of Commerce. Thus he has the good will of the two governments immediately concerned in the Bermuda experimental seadrome, the Langley.

Present plans for the Langley call for a steel landing deck 1,200 feet long, with a central section 400 feet wide and ends 200 feet in width. On the wide central section of the deck are housing facilities, comprising hangars, shops, stores, restaurants, meteorological and radio departments, passenger and crew quarters. Provision is made for an airway and seadrome personnel of approximately 80, making the total provided for, including passengers, over 120 persons.

The deck is supported through a system of steel trusses by 52 steel and iron circular columns, spaced approximately 100 feet apart, each 15 feet in diameter, the deck being normally 70 to 80 feet above sea level. Each column terminates in an iron buoyancy tank, 35 feet in diameter by 30 feet deep, the top of which is 25 feet below the sea level. Each buoyancy member, of 1,100 tons displacement, is divided into 12 watertight compartments, some of which are used for water ballast and fuel storage for both planes and seadrome power plant.

Below the buoyancy tanks are the fixed-ballast tanks, the ballast being iron ore, to give the concentrated loading necessary to bring the center of gravity below the center of buoyancy. The ballast tanks are of shallow depth but 70 feet in diameter, so as to develop the maximum damping effect.

The open-work type of construction permits the largest waves to pass through without breaking them up or in any way interfering with their regular motion. The deep draught insures support for the structure in the still water underlying the wave disturbance. Anchored at one end and unaffected by waves, it trails into the wind, irrespective of the direction or size of the waves, at any wind velocity exceeding fifteen to twenty miles an hour.

The total displacement of the seadrome will be about 40,000 tons, approximately one-third being ballast. About 6,000 tons of steel will be required in the superstructure and 2,000 tons of iron in the submerged section.

In reference to the effect on transatlantic steamship traffic, Mr. Armstrong estimates the volume of air traffic by present transatlantic travel, although he believes that, with airplane travel making the trip in from 24 to 36 hours, it would shortly double or triple the present traffic volume, so that within a few years there would be over 6,000,000 passengers a year, utilizing not only extensive fleets of airplanes but requiring considerable additions to the shipping fleet, both freight and passenger, the latter being of the slower, more economical type, the trend of which is now discernible.

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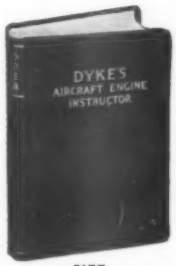

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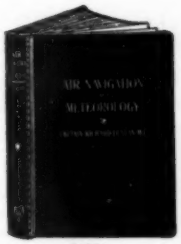

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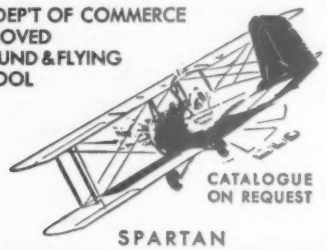

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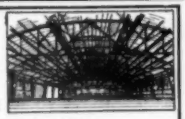

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HOW AIRPLANES ARE DESIGNED [*Continued from page 18*]

must have speed and carrying capacity. Also, it requires stability and its maneuverability can be reduced. The size and altitude of the various fields whence the plane will operate may impose certain limitations on landing and take-off speeds, which considerations will be reflected in several phases of the design.

There are a whole host of such items to be studied but at the end of the study the engineer can set down a number of definite features which must be incorporated in the finished product. These will include an engine of such-and-such type and horsepower, gasoline tankage of so many gallons, so much passenger or cargo space, so much wing area, so much tail surface to balance the wings and many other lesser items, but they will all be very general indeed and their positions with relation to one another will hardly have begun to be considered.

Knowing something of the various structural materials that can be employed, the designer's next step is to make a preliminary weight estimate. One of the main secrets of successful design is the ability to make a reasonable approximation of what the finished plane will weigh and then to hold the completed craft down to that figure. This requires much experience and very careful supervision, as without exception airplane projects tend to gain steadily in weight up to the time of completion. Failure to observe this requirement has often blocked the success of many designs which otherwise showed great promise.

In making this estimate it is usual to divide the plane into its components, such as wings, tail group, fuselage, power plant and so on and then to subdivide these further so that in the final analysis estimating the weight, for instance, of an aileron will consist of figuring so many feet of such and such sizes of steel tubing, plus so much metal added in welding, plus such and such fittings. Estimates may be quite accurate, as the weights of various sizes of tubings are easily ascertainable and approximately similar fittings may be tossed into a scale pan and weighed individually. Certain factors, too, are usually known definitely beforehand, as the weight of the engine, the weight of the instruments, and the useful load the plane is to carry. Moreover, as the design is brought nearer completion, the weights can be computed with increasing accuracy, but the scales always have the final word and they always name a higher figure than the engineer.

The preliminary weight estimate is used as a basis for determining the wing areas—and sometimes also the wing curve or airfoil section—and the general proportions of the ship. Detailed design begins with a scale drawing showing the side of the fuselage. Engineers usually consider it best to locate first the engine, fuel, pilot and possibly the armament in their desired relative positions in this drawing and then to fill in the less important items and determine the general outline of the fuselage.

The center of gravity of the fuselage is calculated by locating the centers of gravity of the various parts and using their estimated or known weights considered as forces applied to a beam. Location of this center of gravity determines the location of the wings and landing gear. Its position with relation to the wings is extremely important; should it be only a few inches forward or back of the proper position the ship may be wholly unmanageable in flight.

When the side view of the fuselage has been completed, a plan view and a front view are drafted. From these the performance and stability characteristics are calculated. Several changes may be necessary at this point as theoretical computations, based on information obtained from test flights of other planes, enable experienced engineers to determine these matters very accurately while the plane is still on paper. Thus, should a given design fail to show proper stability, the matter can be corrected by changing the stagger or relative position of the wings, by increasing their dihedral angle, by adding to or reducing the amount of sweep-back, by re-disposing part of the weights or by other means.

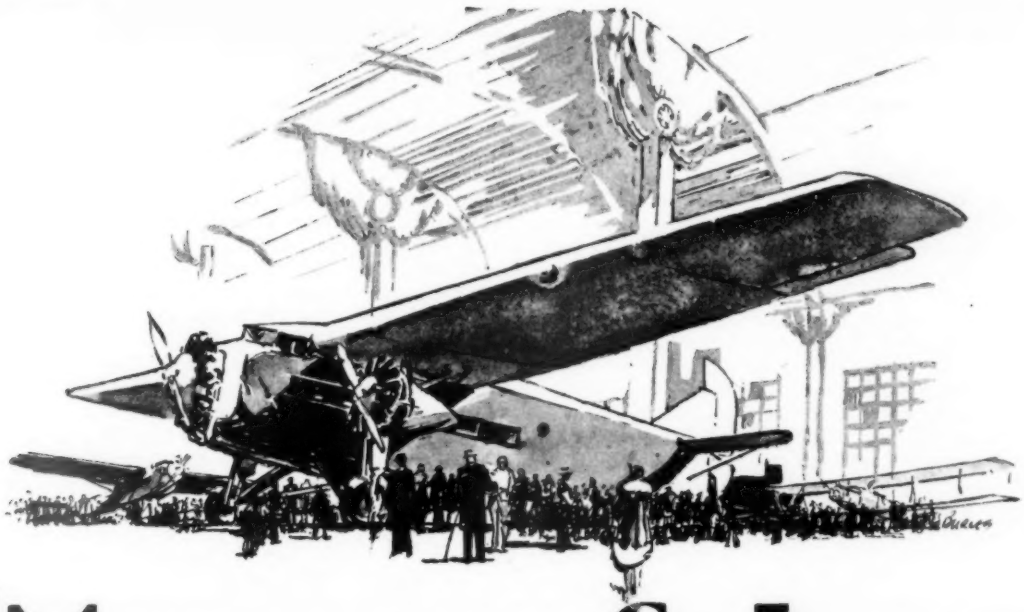
If still more accurate determination of the plane's characteristics is desired, a very accurate wooden model of the craft is tested in a wind tunnel. This is almost always done if the new design is at all radical. It is a very expensive process, but produces very valuable results.

The model is mounted, generally upside down, on wires in the tunnel, these wires being connected to scales; air is then forced through the tunnel at a known speed. As conditions are the same whether an airplane moves and the air is still or the air moves and the plane is still, the circumstances of flight are perfectly simulated and the strains set up in the wires can be read off directly on the scales as so many pounds and ounces of lifting ability and of "drag," or resistance to forward progress.

Owing to certain peculiarities of aerodynamics, such tests with models do not give results entirely proportionate to those which would be attained with full sized airplanes; consequently in one or two places huge wind tunnels have been built to accommodate the actual planes themselves, though thus far none have been built of sufficient size for the testing of very large aircraft. Nevertheless, the wind tunnel tests are considered very highly. They are especially valuable in making comparisons of various designs so that the best may be selected for manufacture.

Having completed the performance calculations and the wind tunnel tests, if any are made, and made such modifications in design as appear to be justified, the next step is to build a dummy plane, or "mock-up." This is a "life-size" reproduction of the major portions of the aircraft, i. e., the cockpit, forward portion of the fuselage and enough of the wing so that visibility can be determined. Often an actual engine is installed in its proper position in this "mock-up." Generally the cockpit is equipped with instruments and controls. Then various pilots and designers can climb into the dummy cockpit and ascertain for themselves the comfort of the arrangements, whether the controls are conveniently placed, how readily the instruments can be seen and how much visibility is afforded. This is an extremely important matter as it directly affects the ease and safety with which the plane can be operated.

Seated within a maze of wings, wires, and struts and with part of his view blocked off by the very fuselage which carries him, a pilot has at best all too many visual obstructions. The designer's task is to place things in such position as to offer minimum interference, particularly with his view of the ground when landing or taking off and with vision forward so that he can see his objectives—as for instance, locating a flying field at some distance. In the case of military aircraft, visibility above, behind, and both sides is extremely important. In fact, a military pilot would prefer that he have visibility simultaneously in all directions not interfered with even by the back of his head. It is all just



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another question of compromising and revising in which the experiments with the mock-up help a great deal. The designer does his best to provide a maximum of visibility in those directions where it will be of greatest service.

The mock-up also is used to determine the degree of comfort, roominess and convenience that can be given the pilot and passengers. Thus in a commercial airplane the experiments may show that it is advantageous to place the windows slightly higher or lower, that a writing desk may be located in front of this seat but not in front of that; that greater leg room can be had by staggering the position of the chairs, or that the space allowed for an aisle is wider than necessary and hence that the seating arrangements can be re-designed to give greater comfort.

When changes indicated by these experiments have been completed, it is customary to make what is called a "profile" of the inside of the fuselage. This is a sort of a section drawing from front to rear which shows everything that is to be installed in the completed structure, such as instruments, pipe lines, controls and even wiring. It is usually on a large scale—three inches to the foot—and its object is to prevent structural interferences. Sometimes, when pressure of time has prevented making of a profile, final assembly of the plane has confronted the designer with the necessity of putting two things in the same place at once, such as running a strut through the oil tank.

About this time the stress analysis of the plane is made. As there are at least half a dozen different conditions in which an airplane is put under strain, the stresses set up in each member of the structure must be analyzed for many distinct loads. Thus, when a plane is diving or flying at high speed, or landing, or in a stall, or—as military aircraft often are—flying upside down, or rolling, the loading is different from what it is in any other position. Yet every part of the aircraft must be strong enough to take these widely varying strains without failure and still must not be needlessly strong, for unnecessary strength means unnecessary weight. Stress analysis work is usually divided among a number of experts and in spite of their best efforts always requires a good deal of time.

Because of the difficulties of analyzing stresses in complex parts, it is often necessary to make samples and test them in loading machines. This also is done when there is a question as to whether a certain part will be able to carry a required load. Thus, wing ribs made of wood—a material whose strength characteristics are not always readily ascertained—are often tested in a machine which distributes the loads throughout their length in the same manner that the loads are distributed in actual flight. Should the rib give way at one point only, that point is strengthened or other points are weakened by cutting away material until increasing loads cause a failure throughout the most of the structure. This sort of testing assures that the rib will be strong enough everywhere to carry its burden and at the same time not overweight anywhere.

Frequently complete wing structures or tail assemblies, or even fuselages, are made up just as if they were going into an airplane and then loaded with bags of sand or other weights until they have demonstrated their ability to withstand every flight strain with an adequate margin of safety.

This analysis and test work is a long process but not until it is completed can the detailed design of the hundreds of different parts that go into the plane be carried out. Each of these parts must be drawn in detail, thus necessitating several drawings for each one. In a standard mail plane of well known type there are more than 22,000 parts, 9,000 of which are different. Thus there are about 27,000 drawings to be made for this type of craft. While in smaller planes fewer parts are required and often a great deal of the detailed designing is omitted, nevertheless the making of the necessary drawings is always a tremendous task. It is usually divided up among as many engineers as are available, all of whose work, however, is coordinated by the designer in charge.

When all the tests have been finished, all the analyses completed and all the apparently necessary changes made, the first experimental plane is built up. By this time the total weight is pretty accurately determined, since every part that has gone into the aircraft has been weighed as it was assembled. The numerous changes which have been necessary, however, and the inevitable variations from designed weights are pretty sure to have affected the location of the center of gravity a little. This is one of the things that causes the engineer to worry and when perfect performance in the air reassures him, as it did the lean, brown individual already mentioned, there is cause for general rejoicing.

If, however, "the c.g." should be only slightly out of place, a little variation in the weight of the tail or the area of the stabilizer may correct it. In general, if the center of gravity is too far forward, there is less to worry about than if it is too far to the rear, for if the latter is the case, a new engine mount must be built to move the engine forward, and this of course calls for numerous changes in controls, fuel lines, oil lines, and cowling.

Assuming the balance is correct, or is easily made so, the ordinary procedure is to run the engine on the ground for several hours to make sure that it is all right and that all the controls function satisfactorily; then the ship is ready for its first flight.

The test pilot puts on his parachute, the mechanics give a last-minute inspection to the control surfaces, the fuel tanks are refilled, somebody checks the oil supply and the engine is "wound up." The pilot "opens her up wide," slows down; the chocks are pulled away and he rolls out on to the field. Some test pilots prefer to taxi about a little in order to "get the feel of her;" others merely "point her nose into the wind and let her have it."

The first few hundred feet are the most dangerous. After that, should the plane prove unmanageable, the pilot may have recourse to his parachute. At first straight flying is the rule, with easy banks and wide, gentle turns but as the pilot learns more and more the feel of the ship and gains more and more altitude he generally increases the sharpness of the various maneuvers until he has made the plane do everything of which it is capable.

This requires a number of flights, in the intervals between which the mechanics inspect various portions of the structure for signs of weakening or stretching, remedy any errors in rigging which may have become evident and possibly make slight changes. Eventually check tests are made to learn the top, cruising and landing speeds, the time and distance of takeoff with varying loads, the rate of climb, and the maximum altitude or "ceiling" to which the plane can be driven.

When these have been completed and any changes in design deemed necessary have been worked out and tested —and there are always plenty of these —the preliminary drawings are replaced with final ones, the work sheets are made out, and design is complete. After that the job belongs to the production department.

"How Oil Companies Use Aircraft" and "Advertising and Air Transportation" are further articles by D. R. Lane that are scheduled for coming issues of Aeronautics.

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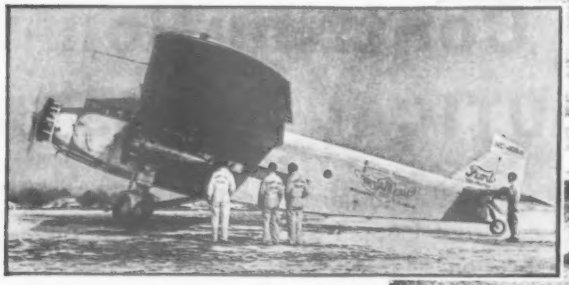

Group of Parks students inspecting the new tri-motored Ford. Each of these men will be given a thorough course of instruction, including five hours in absolute charge of this monster plane.

Parks student fueling new Ryan Brougham—a sister ship to Lindbergh's "Spirit of St. Louis"—which has recently been added to Parks equipment for student instruction.

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DIESEL ENGINES [Continued from page 20]

British Beardmore concern. Experimental work was later carried on with the cooperation of the British government, the original purpose being to design an oil engine suitable for aircraft. Mr. Morgan, of the Westinghouse concern, in a talk before the Pennsylvania section of the Society of Automotive Engineers recently, expressed the opinion that the Beardmore Company probably had done as much in the development of the Diesel engine as any firm in the world.

Turning to troubles encountered in the development of the engine, Mr. Morgan said there had been trouble with the valve gear from the first, which, upon investigation, was found to be due to inadequate lubrication. The valves are located in the cylinder heads and their operating mechanism comprises pushrods with spherical joints. By supplying oil under pressure to these joints, this trouble was overcome. There had been some trouble also from improper clearances in the valve gear. Shims were eliminated as a means of adjusting the clearance and set screws were substituted.

The big end bearings of connecting rods had given some trouble, and the steel shells originally used for the bushings had been replaced by bronze shells from the first, the result being that if the babbitt in one of the shells melted out, less damage would be done to the shaft. There was also some trouble from cracking of the babbitt. At present, the babbitt was applied to the connecting rod directly, and the bearing pressure was reduced, which practically eliminated this trouble. In the original design, there was an oil groove around the bearing, which divided the effective bearing area in halves. This groove had been eliminated.

Some trouble was also caused by fuel pump leakage, but this was overcome by the use of more suitable materials. Of course, if the pump were to give continued satisfactory service, the fuel must be free from dust and grit, which would cut the bearing surfaces, nor must it have a high sulphur content. In the latest design of pump, in which there is one pump cylinder for each engine cylinder, the pump speed has been reduced to half engine speed, which gives more reliable service.

As regards lubricating oil consumption, Mr. Morgan said that he had found that changes in such factors as the jacket water temperature and the lubricating oil pressure accounted for variations in oil consumption from one-half pound to eight pounds per hour. Engineers often consoled themselves with the assumption that the faster the oil was circulated through the system, the faster the heat would be dissipated from the bearing, but there was one most economical rate of circulation from the standpoint of both heat transfer and lubrication, and this should be determined.

Much has still to be learned in the field of high speed Diesels; in the future, research should be carried out along lines of greater coordination between fuel pump characteristics and combustion chamber requirements. "You cannot separate the pump from the atomizer," concluded Mr. Morgan.

In Italy, an engine of the Diesel type for aircraft has been built according to the designs of Senor Garuffa. It is a two-stroke cycle type built both in the vee and radial forms, and is said to have given satisfactory results in block tests.

Nothing so far has been reported from France, to the writer's knowledge, but this is by no means proof that no experimental work has been done there, as there is a natural tendency to withhold information regarding development work of even a partially military nature.

Returning again to Germany, we find The Maybach Engine Company, Friedrichshafen, designers and manufacturers of the aircraft engines used in practically every German airship, including the "Graf Zeppelin," engaged in the development of the high speed oil engine, although along somewhat different lines than their competitors. Dr. Maybach will be remembered as the engineering associate of Dr. Daimler in the early days of high speed gasoline engine development.

The Maybach engine, which is designed in several sizes for automotive, marine, railcar, and dirigible use, is, the writer believes, the only high speed Diesel engine employing air injection. Since most of the advocates of hydraulic injection consider air injection unsuited to this class of work, it is of interest to quote the arguments of the Maybach Company in justification of the adoption of this system. In a pamphlet published sometime ago, entitled, "Why not Airless," the company says:

"If it is desired to produce a really practical vehicle type Diesel engine, it is necessary to deviate from previous design practice and aim at the highest weight efficiency and space economy. In addition, the engine must be very flexible, the same as the modern gasoline engine; that is, it must operate economically and satisfactorily at all speeds and loads. In order to meet these requirements, it was found necessary to employ special measures. It was especially clear that only perfect regulation of the injection air and of injected fuel could give that degree of elasticity which is necessary and desirable. To assure such accurate dosing by metering the liquid fuel alone is absolutely hopeless. It is only necessary to consider what infinitesimal quantities of fuel are involved in fueling such a high speed multi-cylinder engine to realize the fallacy.

"To atomize such small quantities of fuel sufficiently, it is necessary to employ pressures of several hundred atmospheres and such small orifices or cross sections that the difficulties in manufacturing and in keeping the jets clear are immediately obvious. This has been confirmed by experiment. So we were led, naturally, to air injection; only this permits of the fine regulation which is characteristic of the Maybach crude oil engines. There is no doubt that later on it will be found possible to build high speed oil engines on the airless principle which will give as good performance, however, but as yet this development stage has not been reached; probably will not be for sometime.

"As regards the compressor, it is possible to build it so that it will be perfectly reliable. It is only necessary to see to it that it can be inspected eas-

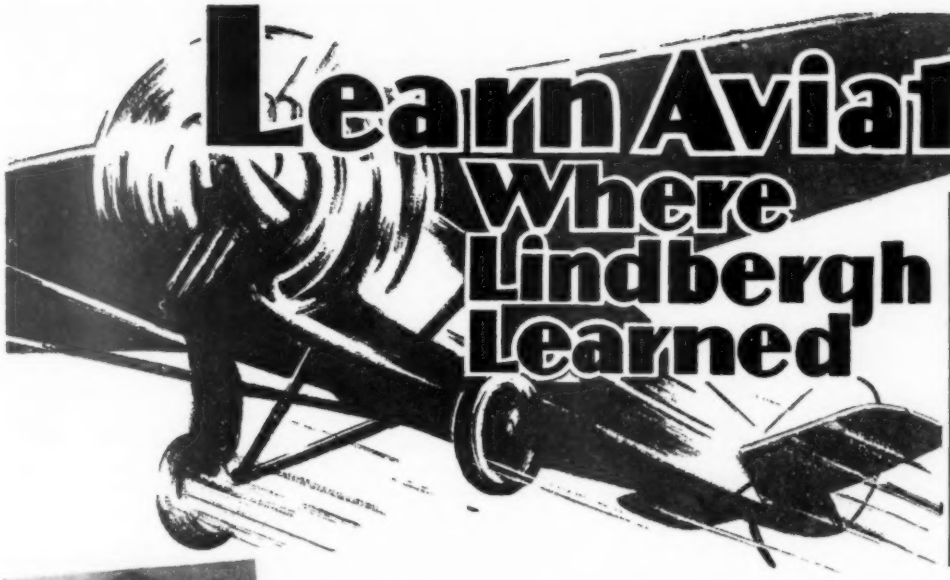
TABLE I.

speed	scavenging pressure	volumetric efficiency
400 R.p.m.	17.5 mm. W.G.	75 percent
600 "	31 " "	72 "
800 "	52.5 " "	70.5 "
1000 "	71 " "	69 "
1200 "	92 " "	68 "

Actual volume of scavenge and charging air is 1.44 times cylinder volume.

TABLE II

Engine speed, Revs.	Fuel consumption in gms/b.h.p./hr. for B.m.e.p. of				
	1.5 at	3.0 at	4.5 at	6.0 at	7.5 at
500	297	212	187	181	193
750	289	204	183	175	179
1000	296	206	184	175	180
1500	332	225	195	187	193



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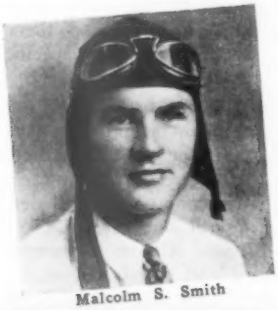

Malcolm S. Smith

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W. Q. Mangold

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Job in 4 Days

"I found all Lincoln instructors most courteous and most willing to give me every help. I most heartily recommend your school.

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ily. It is not necessary to fear undue cooling of the air in the cylinder by the injection air, provided the injection valves are properly designed, as has been shown by long experience with such high speed engines.

"After a thorough consideration of the reasons put forth by the proponents of hydraulic injection, air injection was chosen for the Maybach engine, and thus a power plant was produced, which, on account of its compactness and excellent control, is adapted to replace the gasoline engines thus far used in most applications."

Nearly two years ago, the Robert Bosch Co., Stuttgart, which has been prominent in the manufacture of ignition equipment for Otto cycle engines, entered the Diesel engine field by obtaining an exclusive license under the patents of Franz Lang, owned by the Acro Company. The Bosch Company realized that successful application of the oil burning engine to equipment formerly powered by gasoline engines might effect the market for magnetos and spark plugs seriously, and therefore decided to tie up with the new development at an early date. The Bosch Company points out, that, in the manufacture of fuel pumps and injection valves for high speed engines, especially aircraft, the same class of precision work is required as in the manufacture of magnetos, and it feels that it is therefore particularly fitted to undertake this class of the work. The company, therefore, plans to make only these parts and to license engine builders under its patents, which also cover other features besides those of the pump and injector.

Interest in the possibilities of the Diesel engine in American aircraft circles was stimulated last spring, when a Stinson-Detroiter monoplane flew from Detroit to Langley Field, Virginia, powered by an oil burning engine designed by the Packard Motor Co., of Detroit, for a total fuel cost of $4.68, as against a normal cost for gasoline in a conventional aircraft engine of something more than $25.00, and the interest thus stimulated has since continued at a high pitch among the airminded public at large.

It is only recently, however, that more or less complete engineering data has been available concerning the engine.

According to latest authoritative reports, the engine is a nine cylinder fixed or static aircooled radial capable of about 200 horsepower at 1900 r.p.m. The bore and stroke are 5 inches and 5½ inches, giving a displacement of something like 970 cubic inches. The engine is capable of a brake mean effective pressure of 110 pounds per square inch maximum.

The outstanding technical features of the Packard Diesel, which are organically related both to the essentials of Diesel practice and to aeronautical technology, appear to be the use of a single valve both for the admission of the air and for the discharge of the exhaust gases, and the adoption of a practically 100 per cent constant volume cycle. Firing pressures above 1,200 pounds to the square inch are allowed for in the design, while phenomenally low fuel consumption, low exhaust terminal pressures and temperatures, and a reduction in weight per horsepower to a figure compatible with the characteristic requirements of aircraft are attained.

Operation with aircooling and but a single valve seems to be the radical departure from current high speed Diesel practice, although the monovalve principle seems to have a prototype in an old patent specification of Dr. Diesel's. These features appear outstandingly responsible for the extremely low weight of less than three pounds per horsepower. High combustion pressures, contrary to the now obsolete viewpoint, do not increase the specific weight, because they add to efficiency and power in greater proportion to the extra metal sections required to withstand them. Actually, a net reduction in specific weight is obtained.

The engine is said to have no exhaust pipe and no intake pipe; in fact, no manifolds whatsoever. The articulated system of connecting rod attachment is employed, one of the cylinders being equipped with a master rod. Close to the base of each cylinder is mounted a cam operated fuel pump, with its injection delivery tube leading up to the side mounted spray valve and its suction line branching toward the fuel supply header, which is circular.

EXPERIMENTAL PARACHUTES [*Continued from page 28*]

no swing occurs when it is used.

Its new springless non-foulable pilot parachute increases the safety factor of the new parachute. This pilot 'chute is 30 inches in length and 36 inches in diameter. Shroud lines are not needed as its lobes have partitions which extend to the central elongation and fasten directly to the apex of the mainsail. The pilot parachute, now used as regular equipment with the standard parachute carried by both army and commercial fliers, is actuated by means of springs. In the improved experimental parachute, this actuation of the pilot 'chute is achieved by an entirely different method of packing.

The new parachute pack is provided with rounded corners which insure greater durability and also prevent folds of the silk slipping through. In simulation of the standard parachute, the shroud lines are stowed away in pockets, zigzagged across the bottom of the pack while the mainsail is folded on top. Two pieces of canvas, subjected to great tension by the use of heavy elastics, are drawn diagonally across the shroud lines and mainsail and are fastened under the outside corners of the pack with pins. The pilot parachute is perched on top of these diagonal pieces, being rolled partially in a fold of canvas attached to the outside cover of the pack. This cover as well as the diagonal pieces are extended under the exterior base of the pack and are fastened by the selfsame pins.

When the aviator, forced to take to his parachute as a vehicle of safe landing in time of emergency, pulls the rip cord, the arrangement is such that these pins are withdrawn quickly, even as the diagonal pieces under strong elastic tension draw back sharply, throwing open the top cover and hurling the pilot 'chute out into the wind. The edges of the mainsail skirt are attached to the bottom of the pack with special glove fasteners so that the chute and shroud lines are strung out completely before the skirt bottom is released. This prevents the folds from bunching and keeps the shroud lines from becoming entangled and facilitates the "bellying" of the parachute with air in swift and orderly style.

Major Hoffman reports that the experimental tests made thus far with the improved parachutes equipped with triangular mainsails have evidenced its sterling qualities. The invisible "writing on the wall" predicts that if future tests result as favorably as those already completed, this research will bring about a revision of the standard parachute of the Army Air Corps to incorporate the new factors and features. The standard 'chute with the exception of these invaluable improvements will unquestionably remain unchanged insofar as raw materials used in its manufacture, its size and principles of operation are concerned.

Then it will be only a matter of time until these research results will also effect similar improvements in the average commercial parachute.

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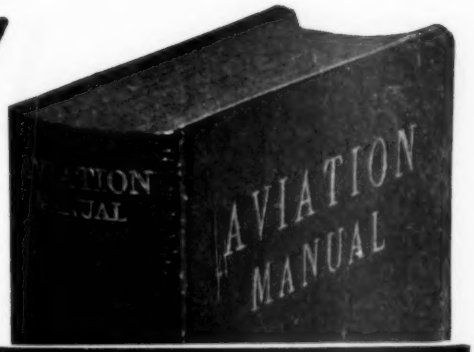

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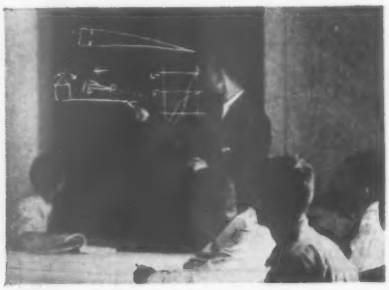

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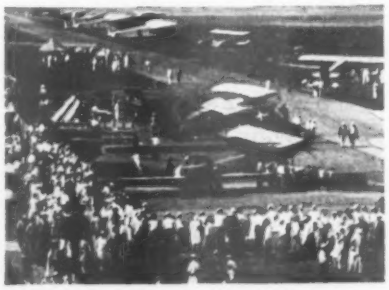

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AERODYNAMICS [Continued from page 42]

property of the airfoil. By turning up the rear trailing edge, it is possible to reduce the center of pressure motion very much. If the turning up of the trailing edge is skilfully done, there is comparatively little loss in maximum lift and little increase in minimum drag.

Analysis of Some Typical Airfoils

In Fig. 6 are shown some typical and frequently used airfoils, the R.A.F. 15, Clark Y and Gottingen 387.

In Table I the characteristics of these airfoils have been tabulated.

The table includes:

1. The maximum of the upper surface. 2. The maximum camber of the lower surface as a percentage of the chord. 3. The position of the maximum camber and its magnitude as a percentage of the chord. 4. The maximum thickness of the airfoil as a percentage of the chord. 5. The depth at 15 per cent of the chord where the front spar is likely to be placed. 6. The depth at 65 per cent of the chord where the rear spar is likely to be placed. 7. The value of the angle β. 8. The angle of no lift which is approximately

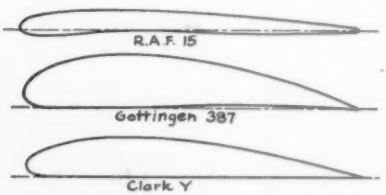

Fig. 6. Above are shown the three types of airfoils. Top, R.A.F. 15, middle, Gottingen 387, and bottom, Clark Y.

equal to β. 9. The working range of angles, that is between no lift and maximum lift. 10. The slope of the lift curve, that is the amount by which the angle measured from the line of no lift has to be multiplied by, to give the lift at any incidence. 11. The center of pressure travel from maximum Ky to maximum ky over 6.25 giving a speed range 2.5. 12. The minimum drag. 13. The best value of the Lift/Drag ratio. 14. The value of the constant Max. Lift/Minimum drag. 15. The best value of the power coefficient K.

It is surprising how closely the actual tunnel values come to the theoretical values.

A close comparative study of these three airfoils will enable the reader to judge for himself of the other airfoil in which he may be interested.

It should be carefully noted that in theoretical considerations of airfoils, the chord should always be drawn from the trailing edge to the extreme leading edge.

Discussion of Table: From the table of actual airfoils we can draw the following general conclusions:

(1) The lift coefficient and the range of working angles increase with the maximum mean camber.

(2) The center of pressure movement increases with the angle β as theory indicates.

(3) The negative angle of no lift is approximately equal to the angle.

(4) The slope of the lift curves are in fairly close agreement with the theoretical slope of .000184.

(5) The profile drag (minimum Kx) increases with the maximum mean camber, and with the thickness.

(6) The working range of angles increases with the thickness.

(7) The best value of $\frac{Ky\ 3/2}{Kx}$ is

about the same for the three airfoils considered.

On the whole, theory checks with experimental values fairly well and certainly offers a powerful weapon for predicting the characteristics of a wing.

The three wings listed in the table are all good wings if used in approximate designs. A consideration of the type of ship for which each wing is suitable is given here:—

R. A. F. 15. This airfoil, due to the small depth of spar, must certainly be used in conjunction with an extremely braced wing. Since the most pronounced features of the airfoil are the low minimum Kx and the low C.P. movement, the wing is very good for a high speed plane in which the major consideration is drag of the airfoil, at small angles of attack.

Clark Y. This airfoil has neither extremely low Kx, high Ky nor very small C.P. movement. However, it has an extremely good value of L/D. It would therefore not be the best for high speed ships, nor for ships desiring a low landing speed. It is, however, very often used on ships which desire good cruising efficiency, that is, a low value of gasoline consumption per mile flown.

Gottingen 387. This section has an advantage from the structural standpoint. That is, it has room for large spars in the wing. Since this is the case, it can be internally braced. It has also a high lift coefficient which means a low landing speed. However, the wing is obviously not good for high speeds due to the high value of the minimum drag coefficient. Therefore, the type of ship on which this airfoil could be used to advantage would be a heavily loaded ship in which load carried was the important factor and high speed was relatively unimportant.

TABLE I

Tabulated comparison of airfoils often used
Aspect Ratio 6
Rectangular plan form

Wing	R.A.F. 15	Clark "Y"	Gottingen 387
(1) Max. camber of Upper surface	5.83%	9.3%	12.7%
(2) Max. camber of Lower surface	-1.02%	2.8%	3.2%
(3) Position of max. camber	26.7%	29.8%	30.7%
(4) Max. thickness	6.36%	11.7%	15.1%
(5) Thickness of 15% of chord	6.36%	10.5%	13.83%
(6) Thickness at 65% of chord	4.90%	8.3%	9.89%
(7) Value of Angle	1.4°	3.1°	5.1°
(8) Angle of no lift	-1.8°	-3.3°	-5.1°
(9) Working range of angles	16.0°	19.5°	23.0°
(10) Slope of lift curve	.000196	.000176	.000163
(11) C. P. travel from Ky max. to Ky max. 6.25	18%	27%	35.5%
(12) Minimum Kx	.000031	.000038	.000060
(13) L/D maximum	19.5	21.0	16.95
(14) $\frac{\text{Max. Ky}}{\text{Min. Kx}}$	86.6	84.2	61
(15) $\frac{\text{Ky } 3/2}{\text{Kx maximum}}$	.73	.76	.73
(16) Maximum Ky	.0026	.0032	.00366
(17) Maximum mean camber	2.30%	3.25%	5.1%

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A LESSON IN STUNTING [*Continued from page 31*]

the stick back until the plane is pointed at the zenith, and hold it there. Even after the airspeed has dropped to zero an F3B will hang for several seconds. As it starts to slip back, throw the stick full forward, and the plane will complete the snappiest loop you ever went through in your life. Once I instinctively pulled back on the stick, which is the movement for a normal loop, as I started to drop tail-first, and the resulting whip forward almost broke my safety belt.

Inverted flight, with its reversed controls, is the most difficult strain on the mind as well as the stomach. The first time I tried it for a few seconds, losing 500 feet and getting liberally soused in a shower of gasoline, I came out with but one thought—"No, I don't care for upside down flying!" But a few minutes later found me rolling over for another try, and somehow I did not mind it as much. The gasoline behaved itself and stayed in the tank, and with my left hand keeping a death grip on a fuselage brace, I hung under the plane for several seconds, each one lasting for hours.

Through constant practice for five or six days running I have learned to hold the stick well forward, keeping the nose above the horizon, and although not yet exactly at ease while hanging from a belt a mile above terra firma, I am at least able to read my instruments, glance around at the rudder, and *look up* at the houses and trees below me.

The next stunt on the program was to try to turn while upside down. After a few sour attempts in the air, I spent half an hour that evening lying on the living-room couch, my feet high in the air figuring out and practicing moving the controls for an inverted turn. The rudder is the only control that remains normal, for to bank for a left turn the stick must be moved to the right, and to keep the nose above the horizon, it must be shoved forward! That half hour of unlogged "flying time" on the couch helped me immeasurably the next day, but the uncomfortable feeling of being thrown outward by centrifugal force each time I attempted a turn soon caused a complete evaporation of my enthusiasm for that particular maneuver.

Single and double barrel-rolls were easier, although I found it difficult to "catch" the plane and hold it in level flight again after two rolls. The tendency is for the plane to keep on rolling into a spin, and unless the opposite rudder is kicked at exactly the right moment, you find yourself in a vertical dive by the time the plane stops corkscrewing. It is hard, at first, for a pilot to keep his bearings.

Have you ever wondered how a fly lands on the bedroom ceiling? Does he land at the top of a half-loop, or does he fly along close to his landing field and half roll in? My little Boeing fighter tried both ways on an imaginary inverted airport a mile above the earth. Then I tried a combination of the two, an inverted Immelman, starting with a slow half roll, and throwing the stick forward for the first half of an outside loop. Plenty of speed is needed at the start, and the strain on the belt is terrific. I must have let the plane fall out of a dozen before I managed to stall through at the top of one inverted Immelman.

A vertical dive is the most breath-taking thrill of all air maneuvers, and one of the most dangerous because of the extraordinarily high stresses which the speed and the pull-out produce. Diving a Navy fighter, with its factor of safety of twelve plus, is safe only when the pilot wears a parachute and pulls the plane out of the dive at a safe altitude. As if on a Gargantuan roller-coaster ride through the heavens, you push the stick to the dash until the shrill screech of the wires drowns out even the racing motor. Straight down . . . down . . . down . . . while you hold your breath as the airspeed needle hits the pin and the plane is still gaining speed. Then finally, the pull-out and 2,000 foot zoom, lying on the back of the cockpit seat and watching the airspeed swing down again to a safe and sane seventy. If you pull out too violently you go "black" as the blood is drained from the head by centrifugal force. It is a weird sensation to retain consciousness and know that you are holding the stick in the cockpit of a plane, and yet not be able to see a thing. The instrument board in front of you fades into a blurred gray and then "the lights go out" completely. As the plane straightens out vision returns in a few seconds and the slight dizziness disappears. Whether or not a pilot goes black on a sharp turn or the pull-out from a dive depends upon the length of time covered by the maneuver as well as upon its sharpness. It can be alleviated to some extent by yelling or shouting, which contracts the lungs and prevents the drain of blood from the head.

No inverted spins or loops were attempted because the outside loop has been expressly forbidden by the Bureau of Aeronautics, and the spin has not been thoroughly enough studied as yet. A few months previous one of the officers in VF-3 had fallen into an inverted spin from an attempted Immelman, and had been thrown out of the cockpit with a broken safety belt after three turns of the spin. He pulled the rip cord and lived to tell the tale, but of course he did not bring his airplane back to the field with him. I had promised my friend in VF-1 to return his plane intact.

With a fast maneuverable plane any pilot can learn to do the most difficult air stunts if only he is willing to practice and practice hard. A perfect slow roll may be more easily mastered by one man than another, but it comes to no one without some time and effort. Such great natural flyers as Lieut. Doolittle of the Army and Lieut. Williams of the Navy have spent years of practice to polish off the uncanny stunts which they can put an airplane through. Most pilots have neither the opportunity nor the willingness to stand the gruelling physical strain which such work entails.

Fear and lack of confidence in flying are the result of inexperience, and the cause of a great number of accidents. Too often this inexperience among new pilots comes simply from an unwillingness to practice maneuvers. A service flyer is not considered a full-fledged pilot until he has been through the mill and piled up 300 hours on all types of airplanes. How much better it would be for the average amateur flyer with from 50 to 100 hours in the air to consciously practice and attempt to perfect his flying rather than to sit back and think of himself as an aviator at last, as so many of them do. Real confidence in the air is bred only by mistakes made and recovered from at a safe altitude, in a safe ship, and seated on a good parachute. There is an old saying that what you don't know won't hurt you, but in flying, what you don't know may kill you.

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It might be regarded by airlines that the air route is attractive to the traveler and business salesman for the saving in traveling time. This is quite an open question. A business man can take a night train out of Chicago and arrive the next morning in Detroit, Cleveland, Cincinnati, Minneapolis, Kansas City or St. Louis. True, it takes him all night to do it, but he has lost none of his valuable business hours and has not interfered with his regular schedule of office hours, meal hours, etc.

If the business man wants to make the trip by air, he has to travel by day—perhaps in only one-third the time it takes him by train—but he *does* have to break up his regular routine, and he does lose a few hours during the day when he needs them most. And he makes this sacrifice at an added cost.

The "Century" an extra fare train operating from Chicago to New York charges less than 4½c per mile. A fare of 7½c per mile on an airway line is considered unusually low.

A Chicago man can go to Minneapolis by train for $14.66 (plus $3.75 for berth) at slightly over 4c per mile (about 5c per airline mile). He can go by plane for $30.00 at a rate of slightly over 8c per mile. True it only takes him slightly less than 4 hours by air compared with 11¾ hours by train. But he has to leave the Chicago airport at 6:10 in the morning, 2 in the afternoon or 11:30 at night. In two cases he'd lose his night's rest and in the other case, lose an afternoon's work. Whereas on the train, he goes to bed at his usual hour and wakes up at his destination in the morning.

This may all seem as though we tended to discount the value of air travel. On the contrary, we think it's well worth an extra price and certain inconveniences to make use of air travel wherever possible. We would travel by air if they used Jennys and made us sit in a cockpit—but would an average sausage salesman use the airplane if he had to get up at 5 A.M. and pay extra for doing it?

In the matter of aerial transportation, the time has not yet come when we can offer the commercial traveler the time schedules and sleeping facilities offered him by the railroad. In due time, perhaps we will. But we can make air travel attractive to him, despite certain unavoidable handicaps, by a rate comparable with rail fare.

The cutting of air fares can not be done with the stroke of a pen. If profits are to be made, a corresponding cut in operating expense must be made.

An excellent step in this direction has been made by the Northwest Airways, Inc. Effective November 15th, they have discontinued including transportation to and from the airport in their regular fare.

On a large transcontinental run, the haul to and from the airport is only a small part of the transportation cost. On a small run however, let us say over the Ball line from Cleveland to Pittsburgh, the cost of taxi transportation must reach about 20% of the total fare. And when we consider the run from Chicago to Milwaukee at $10.00, the transportation to and from the airport becomes a very large portion of the fare.

Of course it is true that the air traveler will still have to pay for his transportation to and from the port probably at a higher rate than he would be paying if the fare were included in his air ride ticket. The whole idea becomes a subterfuge—but one which might intrigue the traveler. One using the railroad does not consider the taxicab ride to and from the station as a part of his railroad fare. When he compares the relative costs of traveling from one point to another by rail or by air, he compares only the actual price of the ticket.

There might be an increased tendency on the part of those driving their own cars, to drive themselves to the port and leave the car at the field until their return. This would be particularly true in cases of hurried business trips where the traveler will be gone only a half day or one day. The transport company could devote a portion of its hangar space to provide storage facilities for the private automobile at regular garage rates.

In this manner a business man could drive to the airport, store his car for the day, and take off for his destination. Upon his return, his car would be there for him to leave the field. It is a fitting development, which has already taken place, for the maintenance of a drive-it-yourself automobile agency at leading airports for the convenience of salesmen arriving from out-of-town. If a regular station could not profitably be maintained, arrangements could be made so that a man upon departure from one city could order a drive-it-yourself car held for him at the point of destination.

The air transport company could arrange with a local taxi firm for a special rate to and from the airport (as is now done in many instances) and if the air traveler wishes to make use of this convenience he could do so—at cost.

The discontinuation of service to and from the airport as an included part of the air-fare between two cities is not the only way maintenance costs can be reduced. But it *is* one way, and every possible saving should be considered by air transport operators if they wish to attract rail travelers by reducing fares to meet railroad competition.

AVIATION INSURANCE

THE analysis of the practice of life insurance companies in the matter of aviation risks has given us a few rather startling facts.

Did you know, for example, that the leading insurance companies, will not accept without extra premium applicants who take more than five flights per year! To be exact, risks that take six flights or more per year are considered with an extra premium ranging from $2.50 to $10.00 per thousand. Furthermore the total amount of insurance allowed and the disability benefits clause are both affected and limited by the number of flights taken. And when any extra premium is added, the usual double indemnity clause for accidental deaths will not be included. And did you know that the standard insurance policy qualifies its clause giving double indemnity for accidental death so as not to include death occurring while engaged as a passenger or otherwise in aeronautics?

We do not attempt to conjecture the effect of this attitude on the development of air travel. It may not have any effect. But it should certainly be studied by aviation leaders.

If insurance companies asked a prospective client how often he took an automobile ride, the client would prob-

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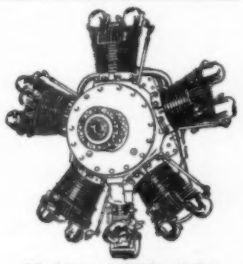

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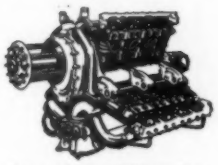

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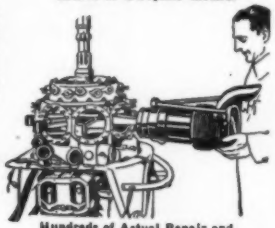

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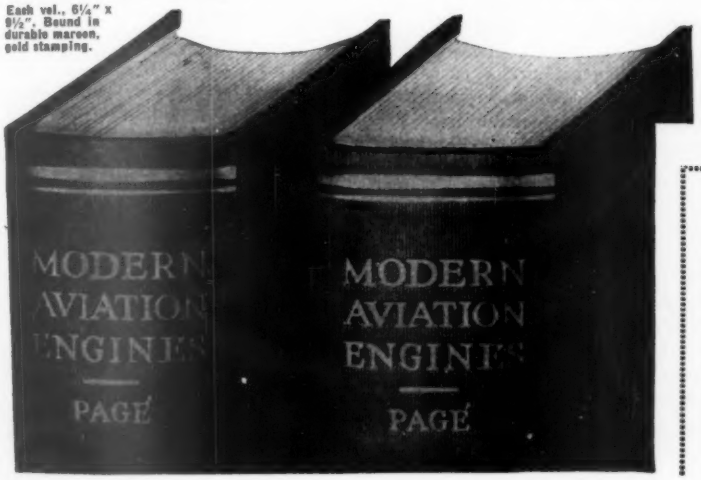

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ably tell the insurance agent to go where such agents are often sent. And if the insurance company charged a man $2.50 extra premium per thousand if he had taken over 45 rides the preceding year, that man would certainly be startled. It appears to us that it is illogical to pass without question automobilists who take 45 or 100 or 1,000 automobile rides a year, and yet place such stringent limitations on the air traveler.

Those wishing statistics on this subject will be interested in the following approximate figures. In 1928 there were 10,500,000 miles of scheduled air transport flying and a total of 22 fatalities. In the same year there were 21,400,000 registered automobiles each of which covered an average of 5,000 miles for the year. There were 26,000 fatalities during the year resulting from the operation of automobiles. This means that one airplane user was killed for every 475,000 miles traversed and one automobile user for every 4,000,000 miles. In other words, the automobile user has nine times the better chance to pull through his mileage than his air-traveling friend (with certain qualifications that any statistical comparison involves). Accordingly if the air traveler has to pay extra for taking six flights, so should the automobilist for taking 54 trips.

A further analysis of general insurance practise brings out even greater discrepancies. Would a bus driver, regularly employed be limited to $5,000.00 insurance and be charged $20.00 per thousand extra premium as is the commercial pilot? Would a car owner driving his own automobile be limited to $20,000.00 and be rated up $15.00 per thousand?

We feel that our readers would be interested in more complete information on insurance practise in reference to aviation risks and are giving below more complete data.

Practice of Life Insurance Companies
Aviation

Licensed Pilots: Passenger carrying over scheduled routes are considered with an annual extra premium of $20.00 per thousand without Disability or Double Indemnity Benefits for a maximum of $5,000.

Mail, Express or Passenger carrying over non-scheduled routes are considered with an annual extra premium of $25.00 per thousand without Disability Benefits, without Double Indemnity for a maximum of $2,500.

Having License, but not regularly engaged in pilot work, but piloting planes for a few flights annually are considered with an annual extra premium of $15.00 per thousand, with Disability Benefits and Disability Benefits Aviation Restriction Clause but without Double Indemnity for a maximum of $10,000.

Applicant owning and operating plane with at least 100 hours, flying experience may be considered at an annual extra premium of $15.00 per thousand—maximum amount $20,000, without Disability Benefits. Those having less experience are treated in proportion to such experience.

Applicant owning plane operated by licensed pilot: Extra premium will be based on past and probably future flights. The average of such cases will be at an extra of $10.00 per thousand with a maximum limit of $25,000 without Disability Benefits.

Passengers on Aeroplanes piloted by licensed pilots: If not more than five flights per annum are made, will be considered for reasonable amounts without restrictions.

Six flights and over per annum are considered with an annual extra premium ranging from $2.50 to $10.00 per thousand. Total amount and amount with Disability Benefits will be regulated by flights per annum. When Disability Benefits are granted, the Disability Benefits Aviation Restriction clause will be endorsed in the policy.

The Double Indemnity Benefits (for accidental death, double proceeds) will not be included in a policy where an extra premium is charged.

In determining the number of flights, attention will not be paid solely to what has been done in the past, but also to what is probable in the future.

AERIAL NAVIGATION

[*Continued from page 44*]

forms a tangent to the surface of the earth.

The planes of all great circles pass through the observer's position, so that all the meridians and the equator are shown as straight lines and the parallels are curves. (Fig. 3 and 4).

The meridians of maps on this Projector are shown as straight lines converging towards the poles. Gnomonic charts should be used for plotting all long distance flights, as they allow the *shortest distance* between two points to be laid down at once as a straight line, but apart from this, it has few useful features; bearings, shapes and areas being all distorted, see (Fig. 3 and 4).

The usual form laid map is in reality a combination of gnomonic and Mercator Projector. If "pure" Mercator Projector were used, neither a "representative fraction" or a "scale line" could be used for denoting distance, as the scale of distance varies throughout the map. The scale of a map may be expressed as—

(a) a Statement in Words, e.g. quarter inch to one mile.
(b) a Representative fraction.
(c) by means of graduated scale line.

Using the first method we hear map scales spoken of as being, say, as one inch to the mile or one mile to the inch. There seems to be no very definite rule as to which way these scales are to be

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expressed in words, although the use of fractions in the statement is generally avoided—thus we may say, one inch to one mile, but four miles to one inch, *not* one-quarter of one inch to one mile. On the other hand it is quite common to speak of the equivalent in inches

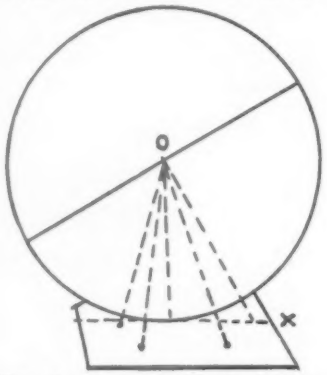

Fig. 2. Great circle Projection.

of one mile as the characteristic of the scale and so speak of the inch map, the half or quarter inch map and so on.

The above is a popular method of referring to maps, but what is known as the representative fraction, is very generally adopted as being a more accurate and scientific manner of expressing "scale." The representative fraction is the ratio of the distance on the map to the distance on the ground. There are 63,360 inches in a mile, therefore, the representative fraction of one inch to one mile $\frac{1}{63,360}$ and the representative fraction of a map on the scale of one centimeter to the kilometer is $\frac{1}{100,000}$

The British and American system of measures produces awkward fractions: for a half inch map the R.F. (Rep. fraction) is $\frac{1}{126,720}$ and for a quarter inch map $\frac{1}{253,440}$.

With the metric system, this difficulty does not arise, since all units of length, large and small, are related decimally. It follows that the R.F. on a map of country using the metric system is a round number, and it has become the practice to speak of "natural scales" meaning thereby, scales for which the R.F. is a round number.

Representative fraction may be written 1/126,720 or 1:126,720 or $\frac{1}{126,720}$

There seems to be no hard and fast rule among catographers regarding this.

Coming now to the *scale line* The scale line is a diagram that permits the translation of distances on the map into distances on the ground, expressed in any unit desired—not necessarily that employed in the first instance when the map was made. It may be convenient to put on an inch to the mile map, a scale of hundreds of yards; or to construct a scale of miles, for say, a map on 1/80,000.

The representative fraction and the scale line are two very important factors. The scale on a map of course, decides the amount of detail which can be indulged in. Normally modern maps are essentially road maps, and special prominence is given to roads. The width of roads, if shown to street scale, would be hardly discernible, and so, in all maps they are exaggerated and if compared to scale, would be found to be some 300 feet in width. This is necessary in order to allow the roads to be readily distinguished. The exaggeration of any one feature, naturally leads to the distortion and in some cases, the complete elimination of others.

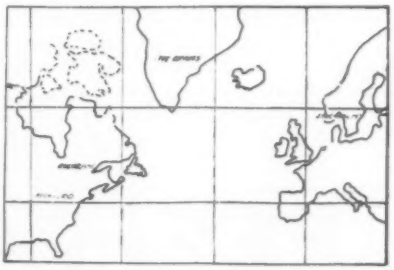

Fig. 3. Mercator chart of North Atlantic.

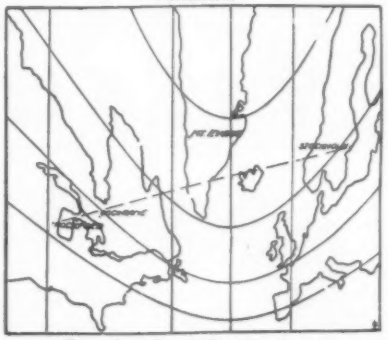

Fig. 4. Great-Circle chart.

So much for maps and scales. In the next article we will consider charts and the conventional signs used in both maps and charts, particularly those in general use by airmen. The ability to read maps and charts, does not require an extensive course in topographical and hydrographic surveying, but it does require practical study of the topographical or hydrographic features (as the case may be) under the direction of an instructor who has the conventional signs at his finger tips and has a knowledge of how things look from the air.

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WOMEN'S ACTIVITIES

EDITED BY LADY MARY HEATH

The Cosmopolitan Club staged its usual annual on December 8. Miss Mary McGhee of Denver was elected president. There are accounts of over 20 aviatrices attending it.

Miss Amelia Earhart has created a Woman's World's Speed Record of 184.17 miles an hour on a Lockheed Vega, a speed of 197 miles per hour is credited to Miss Earhart as her highest speed for any lap. The report on the flight is now undergoing standardization.

Mrs. Keith Miller, Australian pilotess, who last year flew from London to Australia with Captain Lancaster, addressed the members of the Moorestown Club, New Jersey, on December 12. Mrs. Miller is scheduled to fly one of three demonstration planes made by the Victor Company in the East after this appearance.

Mrs. Neva Findley, Paris, whose first entry for the Women's Cross-Continent air race in August came so soon after her licensing, has represented the Curtiss-Wright Airways on a number of recent talks which included the women's City Club, Norwich, numerous Clubs in Philadelphia, and many other places. She, as well as Miss Ruth Nichols, Miss Betty Huyler, Miss Frances Harrell and Miss Fay Sillis, saleswoman for the Curtiss-Wright Flying Service, displayed flying clothing at the Hotel Plaza on November 19.

Miss Grace Lyon plans a trans-Atlantic flight from Roosevelt Field to Ostend, Belgium, next May. It is understood that she has arranged for Mr. Martin Jensen to act as her pilot.

The first tea of New York League of Girl Clubs was held on November 28 and many women pilots were introduced by Casey Jones, the guest of honor.

The Pioneer Woman's Aircraft Dinner was held in the end of last month by the Women's National Aeronautical Association, and by the Illinois Women's Athletic Club. Mrs. Orra Heald Blackmore gave a fine address on women's place in aviation.

December 12 was the day chosen for Mrs. Elizabeth Hiatt Gregory's fine address at the Ritz-Carlton on "The Pioneers of Aviation."

It is understood that at least 26 of the licensed women air pilots of America have joined the Women's Pilot League formed at Curtiss Field, Long Island, in November. They are already engaged in very fine work. Mrs. Paris and Miss Earhart are at present running the organization.

Miss W. V. Royle of the U. of M. Glider Club represented the University of Michigan Glider Club at the meet at Ford Airport on November 23. She took a first place in one competition.

Lady Haig early last month flew with Lady Bailey from London to the Mersey side to take part in Aviation Day celebrations. Lady Bailey's recent solo flight through Africa attracted much attention.

The Maharanee of Cooch Behar, herself a pilot, recently was caught in a seaplane forced landing. Her account of how she "powdered her nose" after carefully beaching her machine makes excellent reading.

Plucky Miss Gentry, rapidly recovering from her airplane crash of August, has heard the bad news that she will not fly again, but she has the splendid pluck to deny this and volunteers her desire for further aviation.

Bloemfontein, South Africa, has put its first lady soloist very successfully into the air. Miss Chrissie Steyn of Oranje School has taken out her license.

A great number of women have followed Miss Earhart's (of T. A. T.) and Miss Koritnik's (air service representative) example. A large number are now employed in the Ryan Factory in the manufacture of wings and parts.

Miss Evelyn Turner and Miss Gertrude Slaton are in Oklahoma City on the Braniff Division of Universal.

Miss Melba Nunn of Kingston, N. C., is an associate of C. A. Dorr at the offices of the Aviation Corporation.

Miss Bobbie Trout and Miss Elinor Smith have made four attempts to put up a Women's refuelling contest. Their last attempt gave them 42 hours, a very fine performance.

Miss Evelyn Matthewson, aged 16, is the United States' youngest pilot. She comes from Detroit, and recently ap-

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peared at the Alexander Airport with her father to purchase—having flown most of the way—an Eaglerock Machine.

Mrs. Ruth Stewart, the first licensed St. Louis woman pilot, is continuing her instructions under the direction of Dan Robertson.

Among the recent honeymooners by air we have James Collins, test pilot, and his wife, Dolores Lacey, of Phoenix, Arizona, Mr. and Mrs. Neuman of the Green Flying School, Chicago, Mr. Donala Babcock and Miss Marjorie Klerger, who both descended by parachute, and Mr. Marchelin Lombard and Miss Barsh Canten, also of New York.

The Women's Flying Club of Houston has just been formed. Ten of the large role are students. A flying mother as well as a flying grandmother are among the ranks. A banquet attended by about 200 persons was recently held.

The Building Committee of the California Flying Club wishes to announce the completion of collection of $100,000 Clubhouse funds and invited the whole world to join them in their ground breaking party on December 8, to which Miss Earhart, Governor C. C. Young, Miss Bebe Daniels, Miss Elinor Smith and many others were also invited.

Miss June Larene has been appointed state representative of the Woman's Division, by the Curtiss-Wright Flying Service of Indiana.

Miss Marion McCutchen of Evansville, Indiana, has gone to Murfreesboro, Tennessee, where she will be stationed at Sky Harbor.

Major Junior College and School for girls at Tarrytown-on-the-Hudson have added a course in Aviation to its curriculum. Professor Roland H. Spaulding is conducting the lectures twice a week.

Miss Ruby Thompson has been appointed hostess at Love Field Airport, Dallas, Texas.

Captain and Mrs. Russell Holderman have just returned to Leroy, New York, after an aerial trip to Camden, S. C.

Miss Winifred Spooner of Great Britain has just flown to Uganda to help form the African Air Mail Line.

Miss Agnes Mills, who received her pilot's license in Florida, has announced her intention of flying alone from New York to Paris via the Lindbergh route.

RUSSIAN FLEET

[*Continued from page 16*]

confining its expansion program to Central Asia, but with Chinese Coast and Japanese cities as the final objective. All development work is under the direction of the Council of Civil Aviation which has ambitious plans to extend the commercial air service into the most remote corners of the Soviet Republics. On every side throughout Russia and Siberia, in Persia and even in Mongolian Centers, a visitor quickly becomes conscious of the very great interest which one and all are taking in the development of aviation. It would appear that Russia and the other more backward countries are trying to bridge over the lack of railroad development with an unusually energetic effort to develop flying. It is equally certain that many communities in Russia and Siberia, from which there is no freight service, will be dependent indefinitely upon communication by airplane. The interest is so keen that at some of the factories the workmen have assigned one per cent of their wages toward the expense of building the World's Greatest Air Fleet.

The "Trotsky Airdrome" at Moscow is the pride of the Fleet and is up-to-date in every respect. Commercial aviation has come to stay in the Lands of the Soviets; and as a preparedness measure in case of war need, it is difficult to estimate the value of any nation having the World's Greatest Air Fleet.

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amateur flying. There are railroads and highways in the Argentine, but not sufficient for her needs. Distances are considerable and as a result flying is a great deal more valuable as a time-saver than it would be in a country more thickly settled.

The Argentine is a great and a rich country. A thoroughly modern country. Its wealth is based on gold standard commodities, that is, staple foods and their by-products. An occasional depression means nothing there because of the fundamental soundness of her industries. Whatever happens the world must eat.

During the three-year period ending in July, 1928, we exported to the Argentine airplanes and their accessories including motors to the value of $246,000, a lesser amount than during the first six months of 1929.

There are twenty well equipped airports scattered all over the Republic, numerous flying clubs and private hangars. There are also several taxi companies and transport lines that operate on regular schedules. These are for the most part earning very satisfactory profits.

The age of machinery has arrived in the Argentine. The farmers are the most advanced in the world. They use more modern machinery than North American farmers. This is of importance to the manufacturer of airplanes because his most likely customers in the Argentine are men who live on and by the soil. The wealth of the country is based almost entirely on its agricultural industries. There is some manufacturing, but no fabrication of metals for the very good reason that metals and the fuel necessary for their fabrication must be imported. To fabricate metals in competition with the United States and Europe would require easily accessible raw materials.

These up-to-the-minute farmers of the Argentine have money. They are machinery-minded and sold on the United States as a source of supply for mechanical devices of all kinds. Europe has not been able to compete successfully with the United States in the Argentine.

The problem of selling accessories is somewhat different from that of distributing airplanes.

The demand for airplane accessories has not yet reached a point that would permit them to be stocked to the exclusion of all things else. Shops selling nothing but airplane supplies may come, but it is doubtful. The auto supply people are pioneering this field and are in a position to hold on to the business they build.

The demand for accessories seems out of all proportion to the number of American-made planes in the Argentine. It is evident that owners of planes made in Europe are owners of accessories and extras made in the United States. This is an encouraging symptom. If our accessories are better and that's conceded, and our motors are better—also pretty generally conceded, then why not an American-made American-equipped plane? It's a logical development. It is not uncommon to see in South America a plane with a European name but with American made motor, landing gear and instruments. Only the fuselage and wings were made in Europe.

The merchandising of accessories can rarely be handled to an advantage by the manufacturer unless he associates himself with others. The South American buyer of accessories wants to buy a

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large variety on one order—one letter of credit—one manifest—and one shipment. The advantages are obvious.

The retailer as a rule is not an importer. He buys from the jobber who imports in quantities, but the jobber also wants to establish connections with a firm or an association able to supply him with a variety of merchandise.

The exporting of accessories can be and ought to be handled in the manner indicated by the needs and wishes of the importer. It would be a tremendous job to buy goggles from one concern, helmets from another and various items of extra equipment from various other concerns.

BRAZIL is the largest of the Latin American Republics having a greater area than continental United States and a population variously estimated between forty and fifty millions. The language of Brazil is a modified Portuguese. The climate is tropical, but tempered by cool ocean currents on the east and high mountains in the interior. A large section of Brazil is frontier country never explored by white men and probably unfit for habitation by Caucasians, being in the tropics, at low altitudes and consequently very hot. But there is a vast Brazil of friendly climate—of great agricultural and mineral wealth.

The city of Rio de Janeiro has a population of more than one and a half million. Rio is famous the world over for its beauty and its agreeable climate. Like Buenos Aires, Rio has its flying clubs and fully equipped airports; its air taxis and transport lines. None of these are too prosperous at this time, but the depression is temporary, induced by the low price of Brazil's chief export—coffee.

Brazil has 20,000 miles of railways of which four-fifths are owned by the Federal Government. There are railway connections with Uraguay, Paraguay, and the Argentine. There are 33,000 miles of automobile roads. Not all of these are paved, but are passable.

The city of Sao Paulo has quadrupled its population since the dawn of the twentieth century. No section of the United States of North America has ever witnessed such building booms as Brazil has enjoyed in the past few years.

The southern part of the country is the best. Here is a climate that can't be bettered anywhere in the world. Here is an inexhaustible storehouse of mineral and agricultural wealth. This section is the most thickly settled in South America.

The people of Brazil are not Caucasians. They are a mixture of Brazilians, White, Indian and Negro. An ethnological jig-saw puzzle, but a fine, friendly and progressive people who are, by the way, most friendly to Yankees.

There is an important mining industry in Brazil and in the south considerable herds of cattle, but coffee is by far the most important of her exports.

Our exports of airplanes and accessories to Brazil for the first six months of 1929 amounted to $189,506. The reports for the last six months are not yet complete, but are expected to bring the total near the half million mark—not a large figure to be sure, but it represents an increase of about 2,000 per cent over the corresponding period in 1928. A similar increase in 1930 would boost the Brazilian business to a very important figure.

The European nations are not blind to the possibilities of Brazil as a market for aircraft. There are regular scheduled flights from Rio to European ports. French, Spanish and Italian aviators have flown from Europe to Brazil. These flights were intended as foundations for regular service between Brazil and Europe, which service has since been inaugurated.

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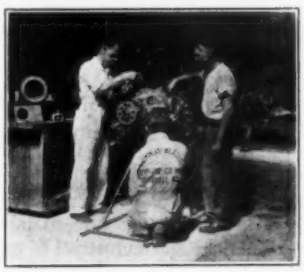

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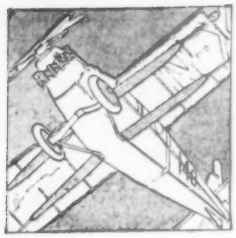

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country. He must remember too that the color line in Brazil is almost non-existent. He will find men of wealth and culture who are not Caucasians, but of a mixed stock that has demonstrated its worth and makes no apologies.

CHILE, the geographical monstrosity. Twenty-seven hundred miles of coast line, but only a hundred miles in width. The Chileans are largely Caucasians. There are considerable numbers of naturalized Germans, Britons, Scandinavians and North Americans.

Chileans are variously described as the Yankees of South America or the Prussians of the new world. They are a bustling energetic people and very much inclined to fight at the slightest provocation. They seem always to win even when they are wrong.

Chile seems on first sight to be the land that God forgot, but there is gold in those barren hills in the form of copper, iron and coal. The barren plains are rich too—rich in the nitrate of commerce. The southern part of the country is devoted to agriculture—mostly to sheep raising which is largely in the hands of the Germans and British.

Chile is one of the South American Republics that prefers airplanes made in the United States. She, Chile, was by far our best South American customer during the first six months of 1929. We sold her planes and accessories to the amount of $662,916, a much larger amount than we sold to her giant neighbors—Brazil and the Argentine.

There is no other country like Chile. She enjoys an unique position in world affairs. Her population is estimated at four million, yet she occupies a position of tremendous influence in international affairs. Her pronouncements are listened to with attention and respect in the capitals of the great nations.

The exploitation of this market is comparatively simple. The people have plenty of money and are thoroughly air-minded. It is safe to predict a greater per capita buying of planes by Chileans than by any other nationals.

These bustling people have a steel mill now and may some day build their own planes, but this isn't likely to happen soon. Meantime there are excellent advertising mediums — publications in English and Spanish. Moving pictures are also well adapted for advertising in Chile. Technical and industrial films are always welcome. The Chileans even pay for the privilege of seeing such films, that is they pay to go to the theater that shows nothing but industrials. It is difficult in North America to get trailers or technical films exhibited. In Chile such films are always welcome providing of course they are well done.

PERU, land of the Incas. It was the wealth of Peru that made possible the Spanish Empire—made of Spain a world power in the 16th and 17th centuries. Peru also prefers Yankee-made machinery including airplanes. Sixty-five per cent of the planes in Peru today were made in the United States and sold by the energetic, good natured Yanks.

In 1928 the German giant, Deutsche-Luft-Hansa, secured a franchise for the operation of a regular transport service in Peru. The first move after the acquisition of the franchise was the purchase of an American plane—a Fairchild five place Cabin monoplane powered with a Wright whirlwind. Our German friends bought this plane for two reasons. First because their prospective passengers, i. e., the Peruvians, have more confidence in the stability and safety of the plane made in the United States. Second because the American product offers more transportation for the money than could be offered by Europeans.

An American, Mr. Faucett, made the first flight from Lima to Iquitos, the capital of the rubber country. A description of the land and water route from Lima to Iquitos may be found in the January number of AERONAUTICS. Since Mr. Faucett's flight there has been a twice-a-week service from Lima to Iquitos.

Our exports of aircraft to Peru during the first six months of 1929 amounted to only $160,000, a small figure compared to Chile, but Peru is potentially richer than Chile and is being developed very rapidly. It is a good plan to keep an eye on Peru.

THIS writer ought not to undertake to write about the United States of Colombia for fear that he be accused of being a propagandist of the Colombian Government. It is hardly possible for one to see the resources and opportunities of Colombia and then to write about them with dignity and restraint. The danger is to understate and at the same time of being accused of overstating.

Colombia is a rich and beautiful country with a culture of its own, but the mountainous nature of the terrain has retarded development of resources because of the difficulty and expense of building highways and railways over or through the high mountains.

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The Grace Lines have recently opened a train and motor bus schedule between Barranquilla on the Coast and Bogota the capital. This combination makes it possible to reach the capital from the coast in two days. Scadta makes it in seven hours. It remains to be seen whether the new service by Grace will cut into the business of the air transport.

It is more likely that the two will help each other and prove of great value to Colombia, whose biggest problem is transportation.

Bogota, some 8,000 feet above the sea and 600 miles from the coast, is the capital of Colombia. The capital boasts a population of almost a million and is a beautiful and progressive city. Other important cities are the ports of Barranquilla and Cartagena. The last named and to a lesser extent, Barranquilla, have enjoyed an oil boom in the last decade and are in a very prosperous condition.

A speaker at a recent gathering of business men stated that Colombia is in very bad shape and must not be regarded as an export market, at least not for the present. The gentleman is making an honest mistake based on the reports of the United States Bureau of Foreign and Domestic Commerce. The department's bulletins are accurate and comprehensive, but to read only the statistical parts of such bulletins is to acquire misleading information.

The gentleman who knew all about the unhappy condition of Colombia had failed to fully inform himself. He read that so many men are unemployed and exports have declined so much, all of which is true, but doesn't mean anything unless accompanied by other information. The present condition of Colombia is only temporary—is due to

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politics and in no way indicates that the country is in bad shape.

Public works of various kinds have been temporarily abandoned; among these are railways and highways. This ought to be of interest to the aircraft industry because the development of aviation is one of the reasons for the abandonment of projected highways and to some extent of railways. The Colombians are so much sold on travel by air that they favor a cessation of the building of roads until it can be determined whether the airplanes will solve the problem that has so long vexed Colombia.

WITH these facts in mind, it will be seen that varying conditions prevail in the different sections of South America and that each territory must be handled as a distinct unit.

However, the rewards for proper exploitation are tremendous and aircraft manufacturers should look into this market as one not only of the present but also of the future.

PRIVATE OWNERS

[*Continued from page 25*]

operation, the more rapid will be the increase of private owners.

Our company is rounding out its line of planes with this prospect in view. We are selling Bach tri-motors, and there will be many private owners in this class. In the Lockheed class, the list of prospective owners is larger. In the New Standard and Avian class, the list is, of course, considerably larger than in the other two. We expect sales to form the leading division of our company this year, and along with sales an increasing demand for service facilities.

At Detroit the municipal airport is already in a crowded condition, brought about largely by the presence of many privately-owned planes. The new hangar, to be one of the largest in the world, will remedy this somewhat, although one cannot but believe that the same situation will arise in another year.

Service facilities must be greatly increased to care for the private owner. Every airport should have a service organization competent to handle any make of plane or engine. Our company is building a large service hangar, to be devoted exclusively to this angle of the flying game.

Designers will do well to meet the requirements of the private owner, and the salesman will do well to study that particular market. Airport operators should prepare to store many privately owned planes, and municipalities should assign certain areas about the airport for the erection of private hangars.

XUM

INTERCOLLEGIATE AERONAUTIC ASSOCIATION

Bulletin No. 1

Edited by Charles L. Morris*

FOREWORD—With this issue of the Intercollegiate Bulletin opens what should turn out to be a very helpful source of information to all those interested in college aeronautics. All college clubs which join the association are required to turn in monthly reports on their activities, from which will be taken excerpts of interest to other clubs. We will attempt to collect reports on various clubs' formation and operation which should help less successful organizations. We shall also print interesting notes on the operation of outside clubs. We shall furnish to members, lists of the association's activities along the lines of securing discounts, insurance, and kindred advantages.

This bulletin is an attempt to encourage inter-relationship between college clubs, in order to bring about a unified effort to advance aviation. We ask your cooperation in this undertaking.

Association Notes—As this bulletin goes to press the dues from but two college clubs have been received at the headquarters of the Intercollegiate Association. The University of Michigan was the first to be heard from. Miss Cornelia Burwell is the secretary of the Airplane Section of the Aeronautical Society and is a member of the executive board of the Intercollegiate Association. This unit has twenty-five members. Yale was the second to respond with memberships for its thirty-five members. The officers of this organization are Charles L. Morris, president; W. Hoffman, secretary; and Daniel T. Moore, treasurer.

Industry Notes—The Intercollegiate Association announces that during the coming year every individual member of member-clubs of the Association will receive a subscription to "Aeronautics." This magazine is one of the most comprehensive periodicals now in circulation, published in the interests of aviation. The Intercollegiate Association, believing it a great advantage to keep in touch with things aeronautical through the medium of a fine publication, has arranged for "Aeronautics" to be sent to each member.

Last Spring we had quite an extensive correspondence with the Davis Aircraft Corporation in connection with their willingness to present a gift ship to that University which could meet the requirements stipulated. The requirements as expressed concerned, in part, the ability of the club to provide competent instruction servicing, repairing, and replacement in case a gift ship was granted.

Several clubs became interested in the proposition, but in a recent communication from the Davis Corporation, several additional stipulations were added, the most salient of which was one requiring the prospective club to purchase one plane before receiving a gift ship. This of course, puts an entirely different aspect on the matter, and appears more or less like a retrenchment on the part of the donors. We are prepared, however, to send more specific information to any club which feels it can meet the condition as stated. The offer is still a good one even with the additional requirements and should be attractive to any club able to meet them.

During the past few months the Intercollegiate Association has been in communication with several prominent manufacturers and flying schools regarding the granting of discounts to members of the Association. Spartan Aircraft Company of Tulsa, Oklahoma, responded with an offer to furnish a plane at cost. The list price of the Spartan plane is $5,470, and is an excellent opportunity for any club ready to purchase a plane. The Kinner Airplane and Motor Corp. of Glendale, Cal., offers motors with slightly defective parts for ground school instruction, at a price of $335 f. o. b. Glendale. The motors are shipped sight draft attached to bill of lading upon receipt of an order and $100 deposit. Illinois-Iowa Airways Company, Inc., will grant a discount of 5 per cent to five or more students enrolling in its course of training at Rock Island, Illinois. The Tred Avon Flying Service, Inc., of Easton, Md., offer their primary course in flying at a reduction of 10 per cent.

Parker & Co. of Philadelphia have made us excellent terms for insurance on aircraft, as quoted by them in a letter to Association headquarters.

*Mr. Morris is chairman of the Executive Committee of the Intercollegiate Aeronautic Association and President of the Yale Chapter.

ANNOUNCEMENT

Aeronautics has been selected as the official organ of the Intercollegiate Aeronautic Association. This association is composed of upwards of 20 individual college clubs several of which own planes or gliders.

At a recent meeting of this association held at Ohio State University, twenty clubs were represented. Among the speakers were representatives from the Cleveland News, Transcontinental Air Transport, Goodyear Zeppelin Corp., Curtiss Flying Service, Dept. of Commerce, Great Lakes Aircraft, University of Pennsylvania, and University of Cincinnati.

We invite the various members of this association to follow the monthly bulletin appearing in Aeronautics, and to call upon us if any service or information is desired.

We further believe that the aeronautical industry can do well by fostering the flying college student—for it is this type of market which is a factor of importance in the selling problem of today and of the near future.

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DEPARTMENT OF TECHNOLOGY

MODEL DEPARTMENT

by Bertram Pond

Fuselage of the "C" Eagle

THE January issue of AERONAUTICS described the wing, rudder, elevator, and propeller for the "C" Eagle model. A list of parts was given for the complete machine. You should refer to the January issue for parts of the fuselage which will be described in the following paragraphs.

Before we start in on the fuselage, however, I have a very good suggestion which many model builders might wish to try on the construction of the wing if you have not already completed it. One model builder sent me a picture showing this model made with a sweep-back wing. The amount of the sweep-back used was about one and one-half inches. That is to say, the entering edge of the wing at the fuselage was one and one-half inches in front of the entering edge at the wing tips. The model flies very well either way, but I know many of the model department readers would like to try this other type of wing.

Fuselage

The fuselage is very simply constructed. The front part consists of 1/20" balsa veneer sanded down slightly and braced on the inside where the greatest strains occur. The rear portion is made in the simplest manner from four balsa strips 5/32" square. These two portions of the fuselage can be made separately if you wish and carefully and securely attached after they are completed.

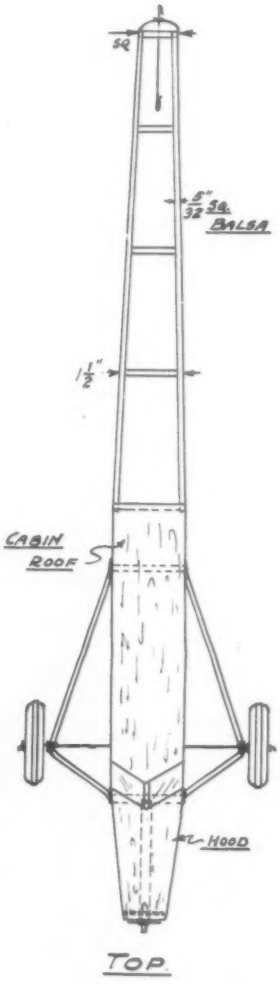
A pattern should be made for the fuselage sides. Remember in making your pattern that the drawing is ¼ size. Using this pattern, carefully cut out two sides from the 1/20"x3"x20" balsa veneer which you should have in your materials. Remember you should sand the veneer before cutting out the body, sides, hood, and bottom pieces as it is difficult to sandpaper these thin veneer pieces after they are once cut out.

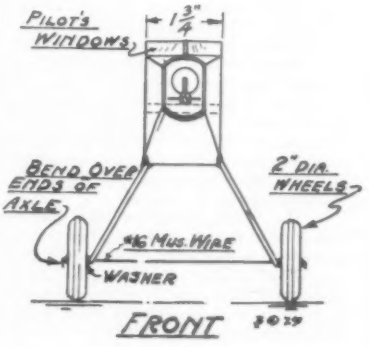
Make a pattern for the balsa hood and the balsa bottom of your fuselage and make one of each of these from your balsa veneer. Carefully mark where the landing gear is to be attached as shown in the drawing and reinforce the balsa veneer by cementing a strip of balsa across the formers as shown in the drawing.

Make a balsa nose piece to the pattern shown in the drawing. This nose piece is made from the 5/32" balsa veneer which you should have in your materials. Carefully cut out the hole through this piece. Don't mind if the piece cracks in two when you cut it as it should be stiffened and protected with a heavy coat of cement all over. You can make a good solid nose piece whether the piece is cracked or not in the making.

Attach the two body sides to this balsa nose piece with cement. Pins should be used to hold the parts together while the glue dries. The bottom sheet of balsa wood can be attached next. A piece of 5/32" square balsa should be cemented across the bottom at the point where the landing gears attach.

Before putting on the balsa wood you should first make the short motor stick from the ¼" square balsa pieces which you had left in making the entering edges of the wing. You will only need a piece about 3" long. This short motor stick should rest in the notch in the nose of the





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	Spruce	Balsa
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1/16"x 1"x3'		.06
1/16"x1/4"x3'	.03	.033
1/16"x1/2"x3'	.045	.054
1/16"x3/4"x3'	.054	.08
1/16"x 1"x3'		.24
1"x 3"x3'		.48
1"x 3"x3½'		.56

Reed 6' lengths, 1/16" diam. .05c; ¼" .075c; 3/16" .10c; Balsa discs ¼" thick 2" diam. .07c; 3" .08c; 4" .09c.

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Rice paper, 18"x24, .09; 21"x25"..... .06
Wood veneer, 20"x30"..... .22
Flat rubber 50' of 1/16", .50; 50' of 1/8"..... .75
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model and on a piece of ¼" square and 1¾" long balsa which you should cement across the fuselage while the hood is still off of the plane. The short motor stick when resting in these two places should be parallel with the position along the line which the rubber will be stretched on the complete model.

The motor stick can be made removable very easily by means of a "U" shaped music wire clip attached to the ¼" balsa fuselage cross piece just above the front landing gear struts. A piece of music wire should be cemented across the inside of the nose piece to keep the motor stick from raising out of the notch into which it sets. To prevent the motor stick from being pulled clear back into the fuselage a piece of music wire should be securely cemented across the front end of the motor stick; or better, this piece can be pierced cross-wise through the front end of the motor stick about ⅛" back and then securely cemented in place. The rear end of this short stub motor base should be slightly pointed to assist in entering it into the "U" shaped clip which supports it at the rear end. This removable motor stick is advisable though you can cement it in place if you wish. However, this makes it more difficult to change the propeller and install new rubber motors.

If you are sure the necessary cross bracing and motor stick mounting is securely mounted in place and if you are sure the edges where the body sides and body bottom pieces join is securely cemented you can attach the hood in place. Note that the hood and under part of the nose are

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Length overall	29 7/8 inches
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both curved to fit the nose piece. To make a good secure joint between the hood and the nose piece use plenty of Hoosier Glu and bind the hood down to fit the curvature of the nose piece by carefully winding several turns of thread around the nose of the fuselage. Be sure and leave this thread on until the glue is thoroughly dry.

While the glue is drying between the different operations on the front part of the fuselage you can save considerable time by starting construction on the rear of the fuselage.

Next cement the roof of the cabin in place and cement a short piece of balsa from the front point of this roof on the center line to the point of the "V" cut out on the center line of the hood. This piece is used to attach the window material for the pilot's cabin.

The rear part of the fuselage should be made as light as possible. To make the construction of this clear to you, if the rear part of the fuselage were stood on end with the rear or little end up in the air it would resemble the framework of a windmill or an oil derrick. Simply cut the pieces to the length scaled from the drawing and cement them together securely with a coat of Hoosier Glu. Holding the parts together with pins while the glue dries, is a great help in speeding up this work.

Note that the rear of the fuselage should be about 7/8" square with a hole in the center 9/16" square. Using the piece of balsa 1" square and ½" thick in your materials, cut a plug which will fit into the 9/16" hole in the rear of the fuselage. Leave a shoulder on the plug 7/8" square so that the rubber motor will not pull the plug through the hole in the fuselage. The position of this plug which sets into the fuselage should be square, of course, so that the rubber motor will not turn the plug in the fuselage. Make a shaft just like your propeller shaft only a little longer and pierce it through the center of

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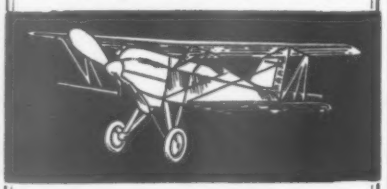

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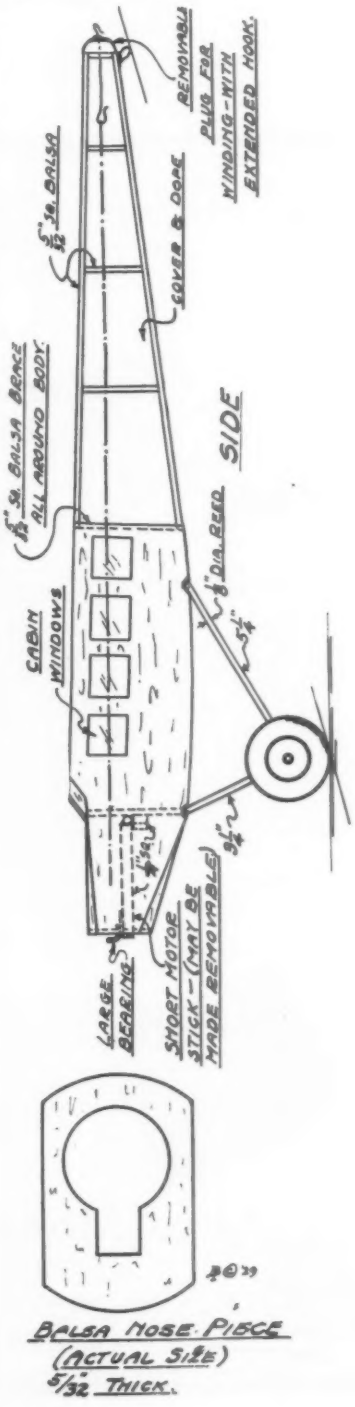

BALSA NOSE PIECE
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1/32 THICK.

this plug. On the rear end of the plug bend a hook like the part of an "s" hook which attaches to a winder. You should bend another loop in this plug to prevent the rubber motor from pulling the hook through the plug. This is very important. Now cement the special hook securely to the plug.

Carefully align the front and rear half of the fuselage so that they fit together properly and so that the overall length of the fuselage is correct. If you have checked and re-checked this alignment to be sure that it is as accurate as you can make it, carefully drop cement on each of the four longerons. Leave the fuselage sit in this position until the glue is thoroughly dry. Then carefully go over these joints again with a second coat of glue. The rear of the fuselage at this point should be reinforced with four balsa pieces 5/32" square around the four sides inside of the body.

With the body this far along, you have only to attach the landing gears, elevator, and cover the rear of the fuselage and cement in the windows to complete the model.

The landing gears are made of 1/8" diameter reed. The front leg should be 3¼" long and the rear legs 5" to 5¼" long. Very securely cement the landing gear in place with several coats of Hoosier Glu. In the front view the landing gear should be 4½" apart at the point where the axle is attached. Be careful to align these landing gear struts so that they appear symmetrical.

If you have a set of materials especially for the "C" Eagle, all you will have to do is to cement in place the bushings furnished with the kit. The axle is made from a piece of No. 16 music wire. A washer is put between the struts and the wheels and between the wheels and the bent-over end of the axle. The axle is fastened to the landing gears with several coats of Hoosier Glu. A small tail skid can be attached at the rear of the fuselage to make the plane more realistic looking.

Now carefully attach the window material over the openings in the pilot's and passengers' cabins. Next paper the rear of the fuselage, stretching the paper as neatly as possible. Special *paper cement* you will find will stick the paper better than banana oil and yet it is much lighter than library paste and other common forms of "stickum." The paper can be doped with a light dope or even with paper cement. A tight covering on the rear of the fuselage is a great help as this stiffens the fuselage so that it will very readily take the strain of considerably more rubber than will be necessary to fly your model.

Next stick the rudder and elevator assembly into position with a small drop of cement for the trial glides. Do not stick it too solidly in place as you may want to change the setting slightly. Next fit the propeller into the bearing on the stub motor base. Then make up a rubber motor of eight strands leaving very little slack or sag in the rubber. To assist in pulling the rubber through the fuselage quickly you can use a string or a music wire hook. Next attach the wing in position with a sturdy rubber band. The gliding position of the wing will be found to be with the rear edge slightly to the rear of the point where the front and rear position of the fuselage were joined. However, this is to be expected since we have no heavy engine in the nose of our model to balance it. You can add dummy cylinedrs made from corks or short metal exhaust pipes and other forms of dummy motors to the front of the nose and bring the position of the wing forward somewhat, and, at the same time improve the appearance of your model without interfering with its flying qualities in spite of the extra weight.

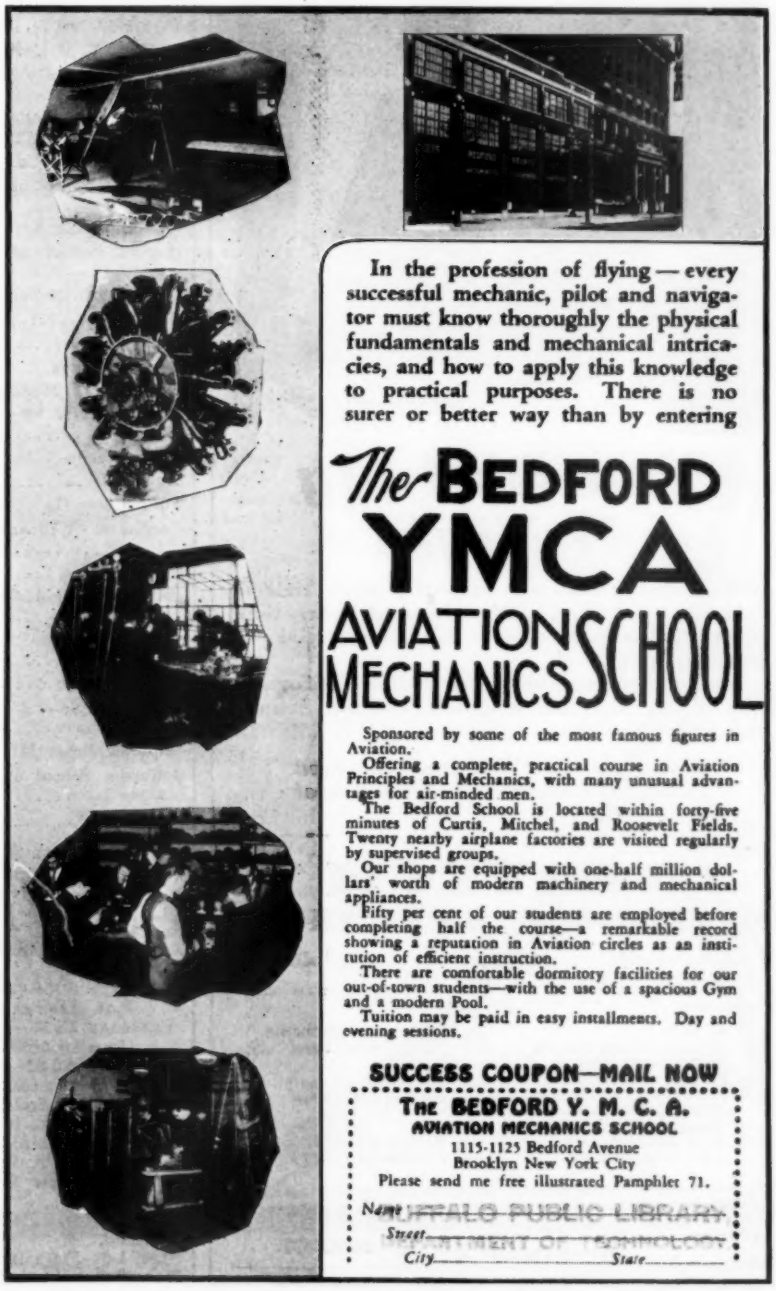
The sweep back wing mentioned in the early part of this article will improve the appearance of the model considerably by bringing the counter part of the wing forward on the body.

In flying the model 225 turns on the propeller hand wound should give you a very snappy trial flight if the adjustment has first been found approximately by gliding.

With an egg beater used to wind the rubber motor by means of the rear plug you can use considerably more turns on account of being able to stretch out the motors.

If you have made your model extremely light and saved weight wherever possible you may be able to fly your model quite well on six strands of 1/8" x 1/32" flat rubber instead of eight strands.

Some very fine flights can be made with this model as it is very light in weight. The model is extremely simple to construct. Combining its simplicity with its realistic appearance it makes a fine model for classes in model building and for anyone who wants a realistic model which will absolutely fly and fly well.



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FEBRUARY 15-23—National Class "A" Show of the Aeronautical Chamber of Commerce, St. Louis.
FEBRUARY 20-22—Second Annual Aviator's Reunion, Aviation Post, American Legion, Chicago.
MARCH 6-15—Second Annual Pittsburgh Aircraft Show.
MARCH 26-APRIL 1—Cincinnati Aircraft Show.
APRIL 5-13—Third All-American Aircraft Show, Detroit.
APRIL 8-9—S. A. E. Meeting, Detroit.
MAY 3-10—New York Aircraft Show, Madison Square Garden, New York.
JULY 6—International Transportation Exposition Opens in Poland.
SEPT. 1-6—Fifth International Air Congress, The Hague, Holland.
NOV. 27-DEC. 14—Aeronautical Salon, Paris, France.